LAWS
OF
BOTANICAL NOMENCLATURE

and other books.

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LAWS

OF

BOTANICAL NOMENCLATURE

ADOPTED BY THE

International Botanical Congress

HELD AT PARIS IN AUGUST, 1867;

TOGETHER WITH AN

HISTORICAL INTRODUCTION AND A COMMENTARY.

BY

ALPH. DE CANDOLLE,

EDITOR AND PARTLY AUTHOR OF THE 'PRODROMUS SYSTEMATIS NATURALIS VEGETABILIUM.'

54894

(TRANSLATED FROM THE FRENCH.)

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NOTE BY THE TRANSLATOR.

In the following translation of M. de Candolle's 'Lois de la Nomenclature Botanique,' precision has been my chief object. I have, on this account, adhered as literally as I could to the original text, only departing from it where the idioms of the French language did not admit of a close rendering into English. It may not be superfluous to add, that in complying with the request of the author that I should undertake the translation, I was actuated rather by a desire to oblige him, than by the hope of being able to do full justice to his work. For the revision of the MS. and proofs, I have to offer my sincere thanks to some kind friends at Kew.

H. A. WEDDELL, M.D.,

Foreign Member of the Linnean Society of London.

Poitiers, *December*, 1867.

PRELIMINARY NOTICE.

THE International Botanical Congress, held in Paris from August 16th to August 26th, under the auspices of the Botanical Society of France, was attended by about a hundred and fifty botanists of different European nations, and even by some few from America.

I had the honour to lay before it a body of 'Laws of Botanical Nomenclature,' drawn up with the view of promoting a systematic discussion, and printed a few days before in Geneva. This work, of which the Botanical Society had taken a certain number of copies for distribution among the members present, consisted of an introduction, of the laws proposed for the regulation of nomenclature, and, lastly, of a commentary, elucidating obscure points, or such as are frequently subjects of debate amongst botanists and zoologists.

The Congress decided on referring my project to a committee consisting of MM. Dumortier, President of the Botanical Society of Belgium, Cosson, Planchon senior, Eichler, Bureau, Weddell, and myself. M. Boreau, of Angers, who had likewise been nominated, was only able to attend the fourth and last sitting. The articles were examined one by one, and I am happy to say that we agreed on almost all of them. Where there was a divergence of opinion, which did

not, however, occur on points of importance, it was decided that less stringent rules should be proposed to the Congress; that authors might be left at liberty to adopt what course they may think most suitable, and the way might remain open to further improvement.

The discussion in congress was remarkably well conducted by M. Dumortier, one of our honorary Vice-Presidents, whilst the President himself, author of the scheme, acted as reporter. In the course of the debates, carried on through several sittings, some useful modifications were introduced into the original text; but no article of primary importance underwent any essential change. Generally speaking, when it was found necessary to vote, a large majority showed how much opinions had been conciliated by discussion. Finally, after a long sitting, on the 23rd of August, at 11 o'clock at night, the following decision was carried all but unanimously, and with manifest satisfaction, by about a hundred botanists of all countries.

The Botanists assembled at Paris, in International Congress, in August, 1867, *having examined the collection of 'Laws of Botanical Nomenclature,' laid down by M. Alph. de Candolle, upon the Report of a Committee appointed by them, resolve :—*

> *"That these Laws, as adopted by this Assembly, shall be recommended as the best Guide for Nomenclature in the Vegetable Kingdom."*

The account of the discussions will be published *in extenso* in the 'Actes du Congrès,'[1] together with the text of the laws that have been adopted; but it would have been difficult, on account of the number and length of other scientific papers presented, to reproduce the Introduction and the Commentary, which are, nevertheless, of evident importance for the better understanding of the articles. Besides which, to ensure a somewhat general application of the adopted rules, it has appeared very necessary, not only that they should be translated into several languages, but also that

[1] 1 vol. 8vo, Paris, 1867, at the office of the Botanical Society, Rue de Grenelle Saint-Germain, n. 84.

they should be published in a shape that will place them within everybody's reach. The volume of 'Proceedings,' edited in French only, and entirely made up of papers on special matters, could not serve this purpose. I have consequently made up my mind to publish, with the assent of the Committee, this second edition of my pamphlet, in French, in German, and in English.

The Introduction does not differ from that of the first edition. The text of the articles is the one adopted by the Congress. The Commentary has been modified in accordance with the changes made in the text of the articles, and completed by the addition of fresh information, or of considerations that have suggested themselves since the sittings. Those who wish to examine the different questions more particularly will do well to consult the volume of 'Proceedings,' together with the present treatise. The details of the discussion, published in the 'Proceedings,' necessarily complete my work, in which, on the other hand, are to be found the Introduction and the Commentary, that do not appear in the official volume. Moreover, the two works being of the same form, it will be easy, for any one so disposed, to annex this pamphlet, printed in any one of the three languages above mentioned, to the volume of the 'Proceedings.'

GENEVA, *October* 15, 1867.

INTRODUCTION.

THE system of nomenclature of organized beings, founded by Linnæus, was looked upon, till the middle of this century, as extremely ingenious, and has been thought, by some authors, a most admirable one. It was quoted in philosophical lectures, and found superior to that of chemical nomenclature, on account of its adapting itself more readily to changes necessitated by the progress of discovery. Botanists professed for it the greatest veneration. They boasted of having developed a better nomenclature than zoologists, which was not surprising, as the most illustrious botanists, thirty or forty years ago, gave infinitely more attention to this subject than zoologists.

Nevertheless, of late years, a change has been perceptible; opinion is wavering, enthusiasm abated. Here and there, in different countries, doubts have arisen and complaints have been made regarding the system of botanical nomenclature. Horticulturists are oftentimes at a loss to find their way in the midst of new names and accumulated synonyms, or are eager to get out of the chaos they have themselves created in the nomenclature of cultivated varieties. Botanists, on the other hand, alarmed at the increase of names proceeding from the different views taken of genera and species, are on the look-out for a nomenclature that shall be

independent of the constant changes in known facts, and modes of viewing them. Botanists and horticulturists exchange jokes on the oddity of garden names, and on the instability of a nomenclature which might well be deemed to possess fixity, having been said to be positive and logical. Happily, they likewise exchange polite and serious requests, with a view of being useful, if possible, or at any rate not hurtful, to one another. I have myself appealed to horticulturists[1] not to give to simple cultivated varieties or subvarieties, Latin names, similar in form to those of genuine species, in order to avoid a source of error in botanical works; while M. Charles Koch, taking advantage of the International Botanical Congress, held in London, in 1866, proposed that such meetings should be utilized for the examination of doubtful questions of nomenclature, and for the introduction of such reforms as should reduce synonymy.[2]

In London, we had only two meetings at our disposal, the *programmes* of which were already very full; besides which, there was no text of propositions to form the basis of a discussion. We separated, in consequence, without having even touched upon the subject. But the words of M. Koch were not lost. He who had then the honour of presiding at the sittings has frequently reflected on the matter since; and when he made known to the Committee for the Organization of the Botanical Congress in Paris his desire specially to treat questions relating to nomenclature, the Committee engaged him to prepare a "code" of laws, so as to facilitate the discussion of those points which might more particularly engage the attention of the meeting.

I have attempted to comply with this desire. Long practice in systematic botany, continuous intercourse with many able men who assist me in working out the 'Prodromus,' and, added to this, the valued recollection of the tendencies imparted to me in my youth, made the task more easy, perhaps, for me than for many others. The subject is so fami-

[1] Bulletin du Congrès horticole à Bruxelles, 1864, p. 171.

[2] Report of the Proceedings of the Botanical Congress, 1866, p. 188.

liar to me, that I have been able to take a very direct course. Without imitating or copying any author, I began by laying down the laws and customs, such as they are followed, or ought, according to me, to be followed in botany, distributing my matter into chapters and sections, so as to put the leading principles in relief, and to bring together closely connected articles. I then read attentively Linnæus's 'Fundamenta' and 'Philosophia Botanica;' the criticism of the first of those works by Heister,[1] Linnæus's contemporary; the chapter on nomenclature in De Candolle's 'Théorie Élémentaire;' Lindley's chapters on nomenclature and synonymy, in his 'Introduction to Botany;' the repertory of laws on zoological nomenclature, presented to the British Association, in 1842, by some very distinguished naturalists, chiefly zoologists,—Strickland, Owen, Darwin, Phillips, Waterhouse, Westwood, etc.;[2] the remarkable preface on the nomenclature of genera in Agassiz' 'Nomenclator Zoologicus;'[3] and, finally, the chapter "De Denominatione Animalium," in Van der Hoeven's 'Philosophia Zoologiça;'[4] purposing, besides, to consult other authors on special points more or less subject to controversy. Their perusal enabled me to make some additions, but, to my great satisfaction, it seemed to me I had obtained certain advantages over analogous works of my predecessors. Linnæus and Heister hardly advert to anything but generic names, for all they say in reference to the specific phrases formerly in use is now inapplicable.[5] The English Committee had principally

[1] Systema Plantarum, etc., cui annectuntur regulæ de nominibus Plantarum a cel. Linnæi longe diversæ, 1 vol. in 8vo, 48 pages, 1748.

[2] Report of a Committee, etc., in Report of the British Association for 1842, p. 105.

[3] One vol. in 4to, Soloduri, 1842-46.

[4] One vol. in 8vo, Lugduni-Batav. 1864.

[5] Linnæus's 'Fundamenta' appeared in 1736; his 'Philosophia' in 1751. The first edition of the 'Species' was published in 1753; but Linnæus had already made use of specific names, systematically reduced to a single word, as far back as June, 1745, in his dissertation on *Amphibia Gyllenborgiana* (Amœn. Acad. i. p. 107), and in botany; and again, in December, 1745, in his dissertation on *Passiflorœ* (Amœn. Acad. i. p. 211). What appears to us, to-day, to be the happiest and

zoology in view. M. Agassiz likewise; and he had not, besides, to deal with species. Lindley, and especially De Candolle, are very explicit, considering the period when they wrote; but many questions have arisen since then. Every author is necessarily led by certain tendencies, by certain exigencies of the times in which he lives; whence it follows that it is useful—every twenty years, for instance—to revise the *ensemble* of received rules. Advantage is taken of this revision to abandon useless rules, and to replace them by more suitable ones. Without going far back, it is easy to see that, since the end of the eighteenth century, botanists have endeavoured to free themselves from many useless shackles put on by Linnæus, and tightened by his disciples; above all, with relation to the choice of generic names. De Candolle was ruled by the idea of having the law of priority properly respected,—a law which, fifty years ago, was often unscrupulously infringed. Authors next aimed at greater precision, and at making nomenclature answer to the growing necessity of dividing the vegetable kingdom into more numerous groups, comprehended one within another.

In the present day, the nomenclature of cultivated species, and of their innumerable modifications, requires special attention. I do not propose any serious innovations in this respect, only recommending botanists to choose, among the various courses in use, those which seem most appropriate, and to establish as close a correspondence as possible be-

most important of Linnæus' ideas, was, for a long time, deemed by him to be of secondary importance; and thus it is that, in the different editions of the 'Philosophia,' all anterior to 1745, he expatiates on the phrase *nomina specifica*, and only mentions what we, to-day, call specific names (his *nomina trivialia*). Among the 186 dissertations of Linnæus, there is not a single one on the names now termed specific. In his dissertation of June, 1753, 'Incrementa Botanices' (Amœn. Acad. iii. p. 377), where he takes the title of reformer of science, and where his works, even the 'Species' that had just appeared, are referred to, he does not advert to the use of the binominal nomenclature. He speaks of it, at last, in his dissertation, 'Reformatio Botanices' (Amœn. Acad. vi. p. 315). in December, 1762, but not to lay down any rules for these names, and merely to insist on the very great advantages offered by them.

tween those variations of species that interest botanists as well as horticulturists, and their more minute subdivisions that interest horticulturists only. The quotation of authors' names after generic and specific names, when changes have taken place, has become an important question, arisen within the last twenty years; and I have even been obliged to turn my attention to the manner in which authors' names are abridged. This detail may appear puerile, but as there are botanists who have fallen into the way of abridging names in an unintelligible manner, it is needful to warn them of it, and to remind them how words are abridged in all dictionaries.

My work consists of a text, followed by a commentary, in which will be found explanations, examples, or reasons in support of the several articles.

I said that some perplexity is arising from the ever-increasing complication of synonymy. Of course, experienced botanists do not feel very anxious on this score. They adopt no new names without having themselves discovered the necessity for so doing,—or, at least, without being sure that they have been approved of, after due examination, by competent men. Moreover, they do not consider synonymy to be without merit. It constitutes the history of the science. Given fully and according to date, it is both curious and instructive. But it must be acknowledged that many people are alarmed at the increase of synonyms, and that, in practice, a multiplicity of names is inconvenient. Some improvements in the system of nomenclature may have a certain influence in this respect. We must, however, learn to face the evil, and to understand that the causes from which it proceeds are very numerous, and partly inevitable. Here are a few comparisons that have not been made before.

In the first four volumes of the 'Prodromus,' published from 1824 to 1830, the proportion between accepted genera and synonymous ones was, approximately,[1] 100 to 55. This

[1] The calculation has been made on the letters A and B of Buek's tables, comprising 277 genera and 154 synonyms, belonging to several distinct Orders, not including synonyms anterior to Linnæus.

amounts to saying that, at that time, about half the number were synonyms. In the 'Genera Plantarum' of Bentham and Hooker, fascicles 1 and 2, published in 1862 and 1865, comprising almost the same series of Orders, I found, by making the same approximative calculation,[1] 117 synonyms for 100 accepted genera. It would seem, then, that the proportion of generic synonyms has been doubled in thirty-six years.

That this increase will long continue in the same ratio does not seem at all probable. As we become acquainted with a larger number of species, it is found more easy to group them naturally, to say nothing of our resources for analysis, which are better than they were formerly, nor of the general improvement of descriptions. For the last forty years a great number of genera have been made from defective materials, but this will be less common henceforth; besides which, we are drawing near the limits of discovery in point of genera. In every fresh volume of the 'Prodromus,' I remark a decrease in the proportion of new genera. There are Orders in which the number of genera hardly varies. Lindley, in 1853, estimated the number of genera of *Euphorbiaceæ* at 191; and it so happens that, in the recent monograph of M. Boissier and Dr. Müller (Prodr. xv, sect. 2), it is precisely 191. I have shown elsewhere[2] that the mean geographical area of genera is about $\frac{5}{1000}$ of the solid surface of the globe. Notwithstanding the exceptional smallness of certain areas, it may be supposed that collectors have now crossed most of the countries occupied by each genus, and that we are thus pretty nearly acquainted with all existing genera. Surely nothing is more uncommon nowadays than the proposal—and, above all, the admission—of a new genus in the floras of the northern hemisphere, without the tropics. For some time longer we shall see genera remodelled,—genera will frequently be formed into sections, or *vice versâ;* but, if we may judge from European floras,

[1] Taking letters A and B of the same index, comprising pretty nearly the same Orders.

[2] 'Géographie botanique raisonnée,' p. 1142.

there will be a limit even to these changes. A plentiful source of synonyms will thus be exhausted.

I just said that we are fast approaching the epoch when all genera will be known. Here is a proof of this, taken from the volumes of the 'Prodromus' that have appeared since 1844, and in which I have taken a special part as author or editor. I divided these into series of three volumes, according to the date of publication, and then counted how many accepted genera there were in each series, and how many of these were new.[1] I computed also the number of accepted and of new species, considering only as new such as had not been described before. I next calculated the percentage of new genera and of new species. The figures show a regular decrease in the proportion of new genera, and a slight increase in that of new species.

Volumes of the 'Prodromus.'	Date of the volumes.	Genera.			Species.		
		total.	new.	percent.	total.	new.	percent.
VIII., IX., X.	1844–46	840	130	15·4	8495	1636	19·1
XI., XII., XIII.	1847–52	602	65	10·7	8308	1783	21·4
XIV., XV., XVI., sect. 2, fasc. 1.	1857–66	476	35	7·3	7832	1864	23·7
	Totals .	1918	230		24,635	5283	

As regards species, the 'Nomenclator' of Steudel, first edition, of 1821, had about 55 synonyms for every 100 admitted species.[2] The second edition, of 1840, gives the proportion of 75 to 100.[3] There is no third edition, to allow of the comparison being continued. The indexes of the 'Prodromus' published by Dr. Buek, for volumes vii. part 2, to

[1] A genus detached from another is looked upon as new, but not so that of which the name only has been changed. The same for species. Genera and species described for the first time had often received names in lists or herbaria. I have considered as new genera and species described for the 'Prodromus,' though sometimes published a short while before in journals, for the sake of priority.

[2] The calculation has been made on the left column of pages 10, 20, 30, etc., to 400, comprising 893 accepted species and 451 synonyms, belonging to a very large number of genera taken at random.

[3] Calculating in like manner, the forty columns comprise 927 accepted species and 702 synonyms.

xiii., which appeared (taking the mean of the years of publication) in 1845, give the proportion of 102 synonyms for 100 accepted species.[1] This divergency from Steudel, in so short a period, may be explained by the circumstance that Steudel did not examine his species one by one, and laid down as admissible all those that had not been done away with by other authors; whereas the writers of the 'Prodromus,' having treated their subject monographically, have been able to revise every species, and have reduced many to the rank of simple synonyms. The detailed indexes of Dr. Buek for the last volume have not yet appeared, but I have no doubt that the proportion of synonyms will be very considerable. According as the volumes of the 'Prodromus' appear, the proportion of synonyms increases. This may continue for a long time yet. The settlement of genera will certainly do away with an important source of synonyms, but there will still be published many carelessly-made species; some botanists will still need the necessary materials for sound work; the conception of species will long vary; and there will always be but few authors that will give themselves the trouble to study every form of a species, or every species of a genus, in the principal herbaria of Europe,—which is indispensable for the avoidance of errors. Works got up in special localities, or devoted to isolated species or small groups of species, or from herborization over limited tracts, or founded upon details from insufficient herbaria; and more general works by incompetent authors, will still continue to be sources of synonyms.

In all this it is clear that nomenclature plays a very secondary part. It facilitates working, by establishing order in facts and ideas, but it does not prevent diversity of opinion as to the limits of genera and species, nor does it place obstacles in the way of superficial, fragmentary works, where the author, shut up in a single country or in a single herbarium, accumulates a number of ill-made genera, and

[1] Calculating in a similar way on pages 10, 20, 30, etc., to 400. They include 816 accepted species and 831 synonyms.

especially of ill-made species, which subsequently fall to the ground.

The time must, however, come when, actually existing vegetable forms having all been described, herbaria containing undoubted types of them,—botanists having made, unmade, or oftentimes remade, elevated or lowered, and, above all, modified some hundred thousand groups, from Orders downwards to simple varieties of species,—the number of synonyms having become infinitely greater than that of admitted groups,—it will become necessary to effect some great revolution in the formulæ of science. This nomenclature that we are striving to improve will then have the appearance of an old scaffolding, made up of parts laboriously renewed one by one, and surrounded by a heap of more or less embarrassing rubbish, arising from the accumulation of pieces successively rejected. The edifice of Science will have been constructed, but it will not be sufficiently clear of all that has served to raise it. Perhaps there will then come to light something very different from the Linnæan nomenclature,—something will have been devised for giving definite names to definite groups.

This is the secret of futurity, of a yet very distant period.

In the meanwhile, let us improve the system of binominal nomenclature introduced by Linnæus. Let us endeavour to accommodate it to the continual and necessary alterations that take place in science, and, for this purpose, let us diffuse, as well as we can, the principles of the method; let us attack slight abuses, slight negligence, and let us come, if possible, to an understanding on debated points. We shall thus have prepared, for some years to come, the way for better carrying out works on systematic botany.

LAWS OF BOTANICAL NOMENCLATURE

ADOPTED BY THE CONGRESS.

CHAPTER I.

GENERAL CONSIDERATIONS AND LEADING PRINCIPLES.

ARTICLE 1. Natural History can make no real progress without a regular system of nomenclature, acknowledged and used by a large majority of naturalists of all countries.

ART. 2. The rules of nomenclature should neither be arbitrary, nor imposed by authority. They must be founded on considerations clear and forcible enough for every one to comprehend and be disposed to accept.

ART. 3. The essential point in nomenclature is to avoid or to reject the use of forms, or names, that may create error or ambiguity, or throw confusion into science.

Next in importance is the avoidance of any useless introduction of new names.

Other considerations, such as absolute grammatical correctness, regularity or euphony of names, a more or less prevailing custom, respect for persons, etc., not-

withstanding their undeniable importance, are relatively accessory.

ART. 4. No custom contrary to rule can be maintained if it leads to confusion or error. When a custom offers no serious inconvenience of this kind, it may be a motive for exceptions, which we must, however, abstain from extending or imitating. In the absence of rule, or where the consequences of rules are questionable, established custom becomes law.

ART. 5. The principles and forms of nomenclature should be as similar as possible in botany and in zoology.

ART. 6. Scientific names should be in Latin. When taken from another language, a Latin termination is given to them, except in cases sanctioned by custom. If translated into a modern language, it is desirable that they should preserve as great a resemblance as possible to the original Latin names.

ART. 7. Nomenclature comprises two categories of names:—1. Names, or rather terms, expressing the nature of the groups comprehended one within another. 2. Names particular to each of the groups of plants or animals that observation has made known to us.

CHAPTER II.

ON THE MANNER OF DESIGNATING THE NATURE AND SUBORDINATION OF THE GROUPS THAT CONSTITUTE THE VEGETABLE KINGDOM.

ART. 8. Every individual plant belongs to a species (*species*), every species to a genus (*genus*), every genus

to an order (*ordo*, *familia*), every order to a cohort (*cohors*), every cohort to a class (*classis*), every class to a division (*divisio*).

ART. 9. In many species we distinguish likewise *varieties* and *variations*, and in some cultivated species, modifications still more numerous; in many genera *sections*, in many orders *tribes*.

ART. 10. Finally, if circumstances require us to distinguish a greater number of intermediate groups, it is easy, by putting the syllable *sub* before the name of the group, to form subdivisions of that group; in this manner suborder (*subordo*) designates a group between an order and a tribe, subtribe (*subtribus*), a group between a tribe and a genus, etc. The *ensemble* of subordinate groups may thus be carried, for uncultivated or spontaneous plants only, to twenty degrees, in the following order:—

Regnum vegetabile.
Divisio.
Subdivisio.
Classis.
Subclassis.
Cohors.
Subcohors.
Ordo.
Subordo.
Tribus.
Subtribus.
Genus.
Subgenus.
Sectio.
Subsectio.
Species.

Subspecies (vel Proles, Angl. *Race.*)
Varietas.
Subvarietas.
Variatio.
Subvariatio.
Planta.

ART. 11. The definition of each of these names of groups may vary, in a certain degree, according to individual opinion and the state of science, but their relative rank, sanctioned by custom, must not be inverted. Any classification containing inversions, such as the division of genera into Orders, or of species into genera, is inadmissible.

ART. 12. The fertilization of one species by another gives rise to a hybrid (*hybridus*); that of a modification or subdivision of a species by another modification of the same species produces a half-breed (*mistus*, *mule* of florists).

ART. 13. The arrangement of species in a genus or in a subdivision is made by means of typographical signs, letters, or figures. Hybrids are classed after one of the species from which they originate, with the sign × prefixed to the generic name.

The rank of subspecies under species is marked by letters or figures; that of varieties by the series of Greek letters α, β, γ, etc. Groups below varieties and half-breeds (mule of florists) are indicated by letters, figures or typographical signs, according to the will of the author.

ART. 14. Modifications of cultivated species should, where possible, be classed under the wild or spontaneous species from which they are derived.

For this purpose the most striking are treated as subspecies, and when constant from seed, they are called races (*proles*).

Modifications of a secondary order take the name of varieties, and if there be no doubt as to their almost constant heredity by seed, they are termed subraces (*subproles*).

Modifications of minor importance, more or less comparable to subvarieties, variations or subvariations of uncultivated species, are indicated according to their origin in the following manner :—1. *Satus* (seedling ; Gall. semis; Germ. Sämling), for a form obtained from seed. 2. *Mistus* (blending ;[1] Gall. métis ; Germ. Blendlinge), for a form arising from cross-fertilization in a species. 3. *Lusus* (sport ; Germ. Spielart), for a form originating from a leaf-bud or from any other organ, and propagated by division.

CHAPTER III.

ON THE MANNER OF DESIGNATING EACH GROUP OR ASSOCIATION OF PLANTS.

SECTION 1.

General Principles.

ART. 15. Each natural group of plants can bear in science but one valid designation, namely, the most ancient, whether adopted or given by Linnæus, or

[1] Since the meeting of the Congress, the author of this pamphlet has, together with the translator, turned his attention to the choice of a significant English term for the French *métis*. The word *blending* does not perhaps indicate quite clearly enough the existence of a mixture, and does not allude to its nature. The term *half-breed*, used by agriculturists,

since Linnæus, provided it be consistent with the essential rules of nomenclature.

ART. 16. No one ought to change a name or a combination of names without serious motives, derived from a more profound knowledge of facts, or from the necessity of relinquishing a nomenclature that is in opposition to essential rules (art. 3, first paragraph, 4, 11, 15, etc.: see sect. 6).

ART. 17. The form, the number, and the arrangement of names depend upon the nature of each group, according to the following rules.

SECTION 2.

Nomenclature of the different kinds of Groups.

§ 1. Names of Divisions and Subdivisions, of Classes and Subclasses.

ART. 18. The names of divisions and subdivisions, of classes and subclasses, are drawn from their principal characters. They are expressed by words of Greek or Latin origin, some similarity of form and termination being given to those that designate groups of the same nature (Phanerogams, Cryptogams; Monocotyledons, Dicotyledons, etc.).

ART. 19. Among Cryptogams, the old family names, such as *Filices*, *Musci*, *Fungi*, *Lichenes*, *Algæ*, may be used for names of classes and subclasses.

appears to answer much better to the sense of *métis; breed* precisely implying a *race*, and *half-breed* the mixture of two races. It may, however, likewise be suggested that the shortness of the French word *métis*, analogous to the Spanish *mestizo*, and evidently derived from the Latin *mistus*, or *mixtus*, will perhaps induce English botanists to adopt it, together with the word half-breed. The latter is undoubtedly more expressive, but metis has over it the advantage of being intelligible in several tongues. The term *mule*, as applied to the mixture of varieties or races, is in constant use amongst English florists; but is too obviously erroneous to be sanctioned by scientific writers. (*Translator.*)

§ 2. Names of Cohorts and Subcohorts.

ART. 20. Cohorts are designated preferably by the name of one of their principal Orders, and as far as possible with a uniform termination.

Subcohorts (rarely used) may be designated in the same manner.

§ 3. Names of Orders and Suborders, of Tribes and Subtribes.

ART. 21. Orders (*Ordines*, *Familiæ*) are designated by the name of one of their genera, with the final *aceæ* (*Rosaceæ*, from *Rosa*; *Ranunculaceæ*, from *Ranunculus*, etc.).

ART. 22. Custom warrants the following exceptions:—

(1.) When the Latin name of the genus from which is taken that of the Order ends in *-ix* or *-is* (genitive *-icis* or *-idis*), the termination *-iceæ*, or *-ineæ*, or *-ideæ* is admitted (*Salicineæ*, from *Salix*; *Tamariscineæ*, from *Tamarix*; *Berberideæ*, from *Berberis*).

(2.) When the genus from which the name is derived has an unusually long name, no tribe in the Order taking its appellation after the same genus, the termination in *-eæ* is admitted (*Dipterocarpeæ*, from *Dipterocarpus*).

(3.) Some large Orders, named long since, have retained the exceptional names under which they are generally known (*Cruciferæ*, *Leguminosæ*, *Guttiferæ*, *Umbelliferæ*, *Compositæ*, *Labiatæ*, *Cupuliferæ*, *Coniferæ*, *Palmeæ*, *Gramineæ*, etc.).

(4.) An old generic name, which has become that of a section or of a species, may be preserved as the foundation of that of the Order (*Lentibularieæ*, from *Lentibularia*; *Hippocastaneæ*, from *Æsculus Hippocastanum*; *Caryophylleæ*, from *Dianthus Caryophyllus*, etc.).

ART. 23. The names of suborders (*subordines*, *subfamiliæ*) are derived from the name of one of the genera that form part of them, with the final *-eæ*.

ART. 24. The names of tribes and subtribes are taken from that of one of the genera included in the group, with the final *-eæ* or *-ineæ*.

§ 4. Names of Genera and of Divisions of Genera.

ART. 25. Genera, subgenera, and sections, receive names, commonly substantive, which may be compared to our own proper family names.

These names may be derived from any source whatsoever, and may even be arbitrarily imposed, under the restrictions mentioned further on.

ART. 26. A name may be given to subsections, as well as to inferior generic subdivisions; or these may simply be indicated by a number, or by a letter.

ART. 27. When the name of a genus, subgenus, or section is taken from the name of a person, it is composed in the following manner:—

The name cleared of titles or of any accessory particle, takes the final *-a* or *-ia*.

The spelling of the syllables unaffected by this final, is preserved without alteration, even with letters or diphthongs now employed in certain languages, but not in Latin. Nevertheless *ä*, *ö*, and *ü*, of the German language become *æ*, *œ*, and *ue*, whilst *é* and *è* of the French language become *e*.

ART. 28. Botanists who have generic names to publish show judgment and taste by attending to the following recommendations:—

(1.) Not to make names too long or difficult to pronounce.

(2.) To give the etymology of each name.

(3.) If they have formerly made a name that has not been accepted, not to establish another genus under the same name, particularly in the same Order, or in a neighbouring one.

(4.) Not to dedicate genera to persons in all respects strangers to botany, or at least to natural history, nor to persons quite unknown.

(5.) Not to draw names from barbarous tongues, unless those names be frequently quoted in books of travel, and have an agreeable form that adapts itself readily to the Latin tongue, and to the tongues of civilized countries.

(6.) If possible, by the composition or the termination of the word, to call to mind the affinities or the analogies of the genus.

(7.) To avoid adjective nouns.

(8.) Not to give to a genus a name whose form is more properly that of a section (*Eusideroxylon*, for example).

(9.) To avoid taking up names that have already been used, but have not been approved, and applying them to genera different from the former, unless it be wished again to dedicate a genus to a botanist; but, even in this case, it is desirable—1, that the nullity of the first genus should be unquestionable; 2, that the order in which it is proposed to re-establish the name be quite distinct from the former one.

(10.) To avoid making choice of names used in zoology.

ART. 29. Botanists constructing names for subgenera or for sections will do well to attend to the recommendations of the foregoing article, as well as to these:—

(1.) Give, where possible, to the principal division of a genus a name that, by some modification or addition, may call the name of the genus to mind (for instance, *eu* at the beginning of the name, when it is of Greek origin; *-astrum*, *-ella*, at the end of a name, when Latin, or any other modification consistent with the rules of grammar and the usages of the Latin language).

(2.) Avoid calling a section by the name of the genus it belongs to, with the final *-oides* or *-opsis;* give, on the contrary, the preference to this final for a section having some resemblance to another genus, by adding, in that case, *-oides* or *-opsis* to the name of that other genus, if it be of Greek derivation, so as to form the name of the section.

(3.) Avoid taking, as a sectional name, one already in use as such, in another genus, or which is that of a genus.

ART. 30. When it is required to express the name of a section, together with a generic name and that of a species, the name of the section is put between the two others in a parenthesis.

§ 5. Names of Species, of Hybrids, and of Subdivisions of Species, either spontaneous or cultivated.

ART. 31. All species, even those that singly constitute a genus, are designated by the name of the genus to which they belong, followed by a name termed specific, more commonly of the adjective kind.

ART. 32. The specific name ought, in general, to indicate something of the appearance, the characters, the origin, the history, or the properties of the species. If derived from the name of a person, it usually calls to mind the name of him who discovered or described it, or who may have been otherwise concerned with it.

ART. 33. Names of persons used as specific names have a genitive or an adjective form (*Clusii* or *Clusiana*). The first is used when the species has been described or distinguished by the botanist whose name it takes; in other cases the second form is preferred. Whatever be the form chosen, every specific name derived from the name of a person should begin with a capital letter.

ART. 34. A specific name may be an old generic name, or a substantive proper name. It then takes a capital, and does not agree with the generic name (*Digitalis Sceptrum*, *Coronilla Emerus*).

ART. 35. No two species of the same genus can bear the same specific name, but the same specific name may be given in several genera.

ART. 36. In constructing specific names, botanists will do well to give attention to the following recommendations:—

(1.) Avoid very long names, as well as those that are difficult to articulate.

(2.) Avoid names that express a character common to all, or to almost all the species of a genus.

(3.) Avoid names designating little known or very limited localities, unless the species be very local.

(4.) Avoid, in the same genus, names too similar in form,—above all, those that only differ in their last letters.

(5.) Readily adopt unpublished names found in travellers' notes or in herbaria, unless they be more or less defective (see Art. 17).

(6.) Avoid names that have been already used in the genus, or in some nearly allied genus, and have become synonyms.

(7.) Name no species after any one who has neither discovered, nor described, nor figured, nor studied it in any way.

(8.) Avoid specific names composed of two words.

(9.) Avoid specific names having, etymologically, the same meaning as the generic name.

ART. 37. Hybrids whose origin has been experimentally demonstrated are designated by the generic name, to which is added a combination of the specific names of the two species from which they are derived, the name of the species that has supplied the pollen being placed first with the final *i* or *o*, and that of the species that has supplied the ovulum coming next, with a hyphen between (*Amaryllis vittato-reginæ*, for the Amaryllis proceeding from *A. reginæ*, fertilized by *A. vittata*).

Hybrids of doubtful origin are named in the same manner as species. They are distinguished by the absence of a number, and by the sign × being prefixed to the generic name (× *Salix capreola*, Kern.).

ART. 38. Names of subspecies and varieties are formed in the same way as specific names, and are added to them according to relative value, beginning by those of the highest rank. Half-breeds (*mules* of florists) of doubtful origin are named and ranked in the same manner.

Subvarieties, variations, and subvariations of uncultivated plants may receive names analogous to the foregoing, or merely numbers or letters, for facilitating their arrangement.

ART. 39. Half-breeds (*mules* of florists) of undoubted origin are designated by a combination of the two names of the subspecies, varieties, subvarieties, etc.,

that have given birth to them, the same rules being observed as in the case of hybrids.

ART. 40. Seedlings, half-breeds of uncertain origin, and sports should receive from horticulturists fancy names in common language, as distinct as possible from the Latin names of species or varieties. When they can be traced back to a botanical species, subspecies, or variety, this is indicated by a succession of names (*Pelargonium zonale*, Mrs. Pollock).

SECTION 3.

On the Publication of Names, and on the Date of each Name or Combination of Names.

ART. 41. The date of a name or of a combination of names is that of its actual and irrevocable publication.

ART. 42. Publication consists in the sale or the distribution among the public of printed matter, plates, or autographs. It consists, likewise, in the sale or the distribution, among the leading public collections, of numbered specimens, accompanied by printed or autograph tickets, bearing the date of the sale or distribution.

ART. 43. The communication of new names in a public meeting, and the placing of names in collections or in gardens open to the public, do not constitute publication.

ART. 44. The date put to a work is presumed to be correct, till there is evidence to the contrary.

ART. 45. A species is not looked upon as named unless it has a generic name as well as a specific one.

ART. 46. A species announced in a work under generic and specific names, but without any informa-

tion as to its characters, cannot be considered as being published. The same may be said of a genus announced without being characterized.

ART. 47. Botanists will do well to conform to the following recommendations:—

(1.) To give accurately the date of publication of their works or portions of works, and that of the sale or the distribution of named and numbered plants.

(2.) To publish no name without clearly indicating whether it is that of an Order or of a tribe, of a genus or of a section, of a species or of a variety,—in short, without giving an opinion as to the nature of the group to which the name is given.

(3.) To avoid publishing or mentioning in their works unpublished names which they themselves do not accept, especially if the authors of such names have not expressly authorized them to do so. (See Art. 36, 5.)

SECTION 4.

On the Precision to be given to Names by the Quotation of the Author who first published them.

ART. 48. For the indication of the name or names of any group to be accurate and complete, it is necessary to quote the author who first published the name or combination of names in question.

ART. 49. An alteration of the constituent characters, or of the circumscription of a group, does not warrant the quotation of another author than the one that first published the name or combination of names.

When the alteration is considerable, the words: *mutatis charact.*, or *pro parte*, or *excl. syn.*, *excl. sp.*, *excl. var.*, or any other abridged indication, are added

to the quotation of the original author, according to the nature of the changes that have been made, and of that of the group that is dealt with.

ART. 50. Names published from a private document, such as an herbarium, a non-distributed collection, etc., are individualized by the addition of the name of the author who publishes them, notwithstanding the contrary indication that he may have given. In like manner names used in gardens are individualized by the mention of the author who first publishes them.

The herbarium, the collection, or the garden, should be fully quoted in the text. (*Lam. ex Commers. ms. in Herb. Par.; Lindl. ex horto Lodd.*)

ART. 51. When a group is moved, without alteration of name, to a higher or lower rank than that which it held before, the change is considered equivalent to the creation of an entirely new group, and the author who has effected the change is the one to be quoted.

ART. 52. Authors' names put after those of plants are abbreviated, unless they be very short.

For this purpose, preliminary particles or letters that do not, strictly speaking, form part of the name, are suppressed, and the first letters are given without any omission whatsoever. If a name of one syllable is long enough to make it worth while to abridge it, the first consonants only are given (*Br.* for Brown); if the name has two or more syllables, the first syllable and the first letter of the following one are taken; or, the two first, if they are both consonants (*Juss.* for De Jussieu; *Rich.* for Richard).

When it is found necessary to give more of a name,

for the sake of avoiding confusion between names beginning with the same syllables, the same system is to be followed. For instance, two syllables are given, together with the one or two first consonants of the third; or else one of the last characteristic consonants of the name is added (*Bertol.* for Bertoloni, so that it may be distinguished from Bertero; or *Michx.* for Michaux, to prevent confusion with Micheli). Christian names or accessory designations, serving to distinguish two botanists of the same name, are abridged in the same way (*Adr. Juss.* for Adrien de Jussieu, *Gærtn. fil.* or *Gærtn. f.* for Gærtner son).

When it is a settled custom to abridge a name in another manner, it is best to conform to it (*L.* for Linnæus, *St.-Hil.* for Saint-Hilaire).

Section 5.

On Names that are to be retained where a Group is divided, remodelled, transferred, or moved from one rank to another, or when two Groups of the same rank are united.

Art. 53. An alteration of characters, or a revision carrying with it the exclusion of certain elements of a group or the addition of fresh ones, does not warrant a change in the name or names of a group.

Art. 54. When a genus is divided into two or more genera, its name must be retained, and given to one of the chief divisions. If the genus contains a section or some other division which, judging by its name or by its species, is the type or the origin of the group, the name is reserved for that part of it. If there is no such section or subdivision, but one of the parts detached contains, however, a great many more spe-

cies than the others, it is to that part that the original name is to be applied.

ART. 55. In case two or more groups of the same nature are united into one, the name of the oldest is preserved. If the names are of the same date, the author chooses.

ART. 56. When a species is divided into two or more species, if one of the forms happens to have been distinguished earlier than the others, the name is retained for that form.

ART. 57. When a section or a species is moved into another genus, when a variety or some other division of a species is given as such to another species, the name of the section, the specific name or that of the division of the species, is maintained, unless there arise one of the obstacles mentioned in Articles 62 and 63.

ART. 58. When a tribe is made into an Order, when a subgenus or a section becomes a genus, or a division of a species becomes a species, or *vice versâ*, the old names are maintained, provided the result be not the existence of two genera of the same name in the Vegetable Kingdom, two divisions of a genus, or two species of the same name in the same genus, or two divisions of the same name in the same species.

SECTION 6.

On Names that are to be rejected, changed, or altered.

ART. 59. Nobody is authorized to change a name because it is badly chosen or disagreeable, or another is preferable or better known, or for any other motive, either contestable or of little import.

ART. 60. Every one is bound to reject a name in the following cases :—

(1.) When the name is applied, in the Vegetable Kingdom, to a group that has before received a name in due form.

(2.) When it is already in use for a class or for a genus, or is applied to a division or to a species of the same genus, or to a subdivision of the same species.

(3.) When it expresses a character or an attribute that is positively wanting in the whole of the group in question, or at least in the greater part of the elements it is composed of.

(4.) When it is formed by the combination of two languages.

(5.) When it is in opposition to the rules laid down in Section 5.

ART. 61. The name of a cohort, subcohort, Order, suborder, tribe, or subtribe, must be changed if taken from a genus found not to belong to the group in question.

ART. 62. When a subgenus, a section, or a subsection passes as such into another genus, the name must be changed if there is already, in that genus, a group of the same rank, under the same name.

When a species is moved from one genus into another, its specific name must be changed if it is already borne by one of the species of that genus. So likewise when a subspecies, a variety, or some other subdivision of a species is placed under another species, its name must be changed if borne already by a form of like rank of that species.

ART. 63. When a group is transferred to another, keeping there the same rank, its name will have to be changed if it leads to misconception.

ART. 64. In the cases foreseen in Articles 60, 61, 62, 63, the name to be rejected or changed is replaced by the oldest admissible one existing for the group in question; in the absence of this, a new one is to be made.

ART. 65. The name of a class, of a tribe, or of any other group above the genus, may have its termination altered so as to suit rule or custom.

ART. 66. When a name derived from Latin or Greek has been badly written or badly constructed, when a name derived from that of a person has not been written consistently with the true spelling of that name, or when a fault of gender has carried with it incorrect terminations of the names of species or of their modifications, every botanist is authorized to rectify the faulty names or terminations, unless it be a question of a very ancient name current under its incorrect form. This right must be used reservedly, especially if the change is to bear upon the first syllable, and, above all, upon the first letter of the name.

When a name is drawn from a modern language, it is to be maintained just as it was made, even in the case of the spelling having been misunderstood by the author, and justly deserving to be criticized.

SECTION 7.

On Names of Plants in Modern Languages.

ART. 67. Latin scientific names, or those that are immediately derived from them, are used by botanists preferably to names of another kind, or having another origin, unless these are very intelligible and in common use.

ART. 68. Every friend of science ought to be opposed to the introduction into a modern language of names of plants that are not already there, unless they are derived from a Latin botanical name that has undergone but a slight alteration.

COMMENTARY.

1. The object of Article 1 is to establish the principle of universality for botanical nomenclature. Article 6 is a consequence of it.

2. The rules laid down by Linnæus were quite arbitrary, and he did not even seek to justify them. (See Phil. Bot. §§ 225, 226, 229, 230, 231.) His antagonist, Heister, followed the same course. Nowadays no one likes to submit to the will even of a man of genius, while many might feel inclined to side with the majority. Article 2 intimates, among other things, that a congress of scientific men may throw light upon a question, or may express an opinion by vote, but cannot impose a rule or prohibit a method.

3. In nomenclature, as in all other branches of science, it is impossible to accept that which implies anything equivocal or false. All rules, or at least all necessary rules, may be considered a development of this fundamental principle. If a doubt arises on a question of nomenclature, the way to clear it is generally to ask oneself whether, by taking one course rather than another, there might result from it ambiguity, false assertions, immediate or possible error. The answer indicates what is or is not allowed.

4. It is impossible to deny a certain right of *custom;* the maintenance of well-known names, of forms in frequent use, often gives clearness or precision, and does away with the necessity of new ones. It would not, however, be right to

sanction any gross error merely for the sake of adhering to habit. It must likewise be borne in mind that exceptions established by custom, being exceptions after all, must neither be imitated nor extended. This is one of the common principles of law.

8. The word *family* has been found a happy one; the genus is, however, that which bears most analogy to a human family, all the individuals that compose it bearing the same name, each of them having, besides, a Christian name analogous to a specific one. Linnæus used the word *familia*, which has the fault of not being very good Latin. The generality of botanists have preferred the term *ordo*, though, in ordinary language, the French and the Germans say *family*. The English alone commonly employ the word *order*. The objection that may be made to it is its double signification in all languages. In French, at least, where style and precision of terms are so much attended to, a phrase such as this, "Le jardin de . . . est arrangé dans l'ordre des Ordres de Jussieu," would appear somewhat ridiculous. A more serious objection has been made to the use of the word 'order' as a synonym of 'family,' namely, that zoologists apply it to a group superior in rank to families. *Orders*, in zoology, answer to what some botanists call *cohorts*; to what Lindley termed *alliances*. This divergency was clearly pointed out by M. Gustav Planchon,[1] and the word *ordo* had been previously employed by M. Dumortier[2] in the same sense as it is used by zoologists; but nevertheless the custom of assimilating the words order and family, especially the Latin word *ordo* to the word 'family' in French and in German, has

[1] G. Planchon, 'Les Principes de la Méthode Naturelle,' Thesis, 8vo. Montpellier, 1860.

[2] Dumortier, 'Analyse des Familles des Plantes,' 8vo, Tournay, 1829. See likewise a note of the same in the Proceedings of the Congress, on occasion of the discussion on this point. Independently of what is relative to the use of the word Order, this able author sets forth ideas on the manner of characterizing groups of families by means of what he terms synthesis; but this is a question quite independent of nomenclature.

prevailed among botanists. The works of Hooker, De Candolle, Endlicher, Martius, R. Brown, etc., being habitually consulted, inconvenience would arise from any change in the signification of the names applied by them to the groups, supposing that a change could be effected, which appears very doubtful. In general, it is easier to introduce a new name than to alter the meaning of old ones. From these different motives the majority in the Committee, and afterwards the Congress itself, maintained the proposal to give to associations of Orders the name of Cohorts, and to apply to Orders the names of Ordines or Familiæ, indifferently.

The word Cohort, *Cohors*, unquestionably good Latin, was employed in this sense as far back as 1818, by De Candolle ('Systema,' i. p. 125), and in 1835 by Von Martius (Conspectus Regni Veget.). Messrs. Bentham and Hooker have adopted it in their 'Genera Plantarum.' We think it preferable to the word *class*, usually taken for divisions of greater importance, and to the word *alliance*, of Lindley, which cannot be so conveniently translated by an analogous word in Latin, *fœdus* having quite another form. *Cohors* is of easy introduction into modern languages, without alteration or with a slight change in the final.

9. Division of species acquires every day more importance. Some botanists call in question the characters attributed to the Species by others, but no one can deny the existence of collective groups of the nature of those called species by Linnæus; and they cannot but allow, at the same time, that there are many other inferior groups, especially among cultivated plants. If the heredity of the forms was always clear and well determined, the division of species would be easy. We should have, firstly, races that might likewise be termed chief varieties, or subspecies; and secondly, non-hereditary varieties. But there is a tendency to heredity in all the forms, only it may be more or less constant, more or less complete. When a modification of a species is habitually hereditary, it becomes, properly speaking, a *subspecies*, in other words, there may be hesitation as to whether it ought not to be called a

species, and many would call it so. If its characters be less striking, and transmission by seed less frequent, every one would then call it a *variety*. A slighter degree in character and in heredity constitute divisions of varieties or subvarieties. Lastly, there are *variations* proceeding from one and the same individual, variations which have a certain tendency to propagate themselves by seed, as may be seen by collecting seed from the branch that produced them. From this step we descend, among cultivated plants, to modifications so numerous and so complicated, that there is no possibility of denominating them, unless we employ peculiar processes, such as we shall mention further on (Article 14).

9, 10. The introduction of the terms *divisio* and *subdivisio*, made by the Congress, has improved the original text. The Committee sought for a Latin word answering to the word *embranchement* used in French by zoologists. No better one was found than *divisio*, which has the advantage of admitting the addition of the particle *sub* for a further degree of distinction. In the actual state of science it is difficult to ascertain whether the scheme indicated in Article 10 will be quite suitable to Cryptogams, but it adapts itself satisfactorily to the ideas generally entertained of Phanerogams. Considering the vegetable kingdom to be formed of two divisions (Phanerogams and Cryptogams), the first would comprise two subdivisions (Monocotyledons and Dicotyledons). Dicotyledons would be divided into two classes (*Angiospermæ* and *Gymnospermæ*); *Angiospermæ* into several subclasses (*Thalamiflorœ*, *Calyciflorœ*, etc., or *Polypetalæ*, etc, according to the author); these into Cohorts, and the Cohorts into Orders.

There may be some hesitation between the terms *sectio* and *subgenus*, as designating the natural divisions of some genera. *Subgenus* is more expressive, but *sectio* has the advantage of allowing a double degree of division, which is sometimes necessary; for *subgenus* can readily be placed between *genus* and *sectio*, so that, by making use besides of the word *subsectio*, genera rich in species or of varied organization, may be subdivided, with great clear-

ness, according to the importance of their characters. It may be added that the word *sectio*, in the sense of subgenus, has become familiar on account of its being adopted in the 'Prodromus.'

The numerous subdivisions indicated in Article 10 may, in many obscure or contestable cases, prevent making new generic and specific names. You scruple to create a genus? make a subgenus or a section. You hesitate about making a species? let it be a subspecies, or a variety. These are general terms, on which all botanists are likely to agree, both those who are inclined to attach importance to slight differences, and those who are not. By this means a multitude of new names, above all of species, that would be contested are avoided.

11. This Article will appear too absolute if we consider the variety of significations given to some words, such as section, class, tribe, in different botanical works; but it is impossible not to admit the pre-eminence of certain works as regards the use of words and forms. A botanist may have ideas in nomenclature preferable, in certain points, to those of Linnæus, Jussieu, De Candolle, Endlicher, etc.; but if he has published no general works to which everybody is obliged to have recourse, the forms that he has used will scarcely be resorted to. This can neither be called injustice nor voluntary exclusion,—it is inevitable. Had Linnæus proposed his binominal method in ephemeral treatises, instead of in his 'Species Plantarum,' it is probable that it would have attracted little attention. The arrangement of the groups which we have given, is very nearly the same as that followed in all the large works that are in botanists' hands. The closer we keep to this unity, the better, however conventional it may be.

12. We have tried to find a Latin word for the well-known and very precise French word *métis*. Dictionaries indicate *bigener*, but the word 'genus' having in natural history a peculiar acceptation, to apply *bigener* to a hybrid, and *à fortiori* to a *métis*, would produce error and confusion. The word *mistus* exists; it answers almost literally to *métis*.

The word has not, it is true, in Latin, the precise sense that we propose to give it, but the same may be said of *genus* and *species*. It is a necessity in science to limit the sense of Latin words, in order to render ideas clearer and more precise.

14. When botanists give their attention to cultivated species, they find no difficulty in designating certain leading forms as races or sub-species, and others less important as varieties or sub-varieties. As a case of this we may mention the paper on *Brassica*, by De Candolle (Trans. of the Hort. Soc., vol. v.), rewarded, in 1821, by the Horticultural Society of London, and recapitulated, under a strictly botanical form, in the 'Systema,' vol. ii., p. 583. In this work races are named in Latin *stirps*, but the word *proles* appears to us better to indicate propagation by heredity. It conforms itself likewise more readily to the addition of *sub*, which has the advantage of designating a sub-race.

Another very remarkable work is that on wheats, by Louis Vilmorin ('Essai d'un Catalogue des Froments,' pamphlet, 8vo, 1850.) Its value as to essential points is evident; but the author has designated the principal forms of *Triticum vulgare*, first by the term *varieties*, and then by that of *sections*. Would it not have been better to call these essentially hereditary forms *races* and *subraces*, the word *section* having already another signification in botanical works?

The important work of Dochmal on fruit-trees[1] offers a still stronger example of this kind of mistake. Genera are there divided into tribes, and species into genera. What would be said of an army having its companies divided into regiments or battalions? or of a country, if certain parishes were to think proper to divide themselves into provinces or counties? of a town if its streets were to be called quarters?

Matters would evidently be improved were agriculturists and horticulturists to adopt the terms used in botany for the

[1] 'Der sichere Führer in d. Obstkunde,' 4 vols. 8vo. Nuremberg, 1855–60. See vol. iv. p. 201, 213, etc.

chief subdivisions of species. With respect to extreme forms of cultivated plants they do not require to be limited. In many cases they are so numerous, so slight, so uncertain as regards origin, and so often complicated by hybridization, that a regular and satisfactory arrangement cannot be expected. Certain species are sought after by amateurs on account of the infinite variety of their shades, spots, size of petals, etc. Many forms spoken of are ephemeral, or very nearly so. They either pass away of themselves, or because fashion changes. To regulate the nomenclature of these many thousand garden productions, would be as impossible as to classify the stuffs that manufacturers produce and name every year. The words *seedling* and *sport*, used in horticulture, have the advantage, first, of being known; secondly, of designating the important fact of their origin; thirdly, of not being too precise as to the degree of fixity and importance of their characters, which are always slight. The words alluded to are easily translated into Latin by *satus* and *lusus*, found in all dictionaries. The English word *sport* (*lusus*) can easily be introduced into the French tongue, where it is already more or less known, its shortness, moreover rendering it convenient. *Spielart* in German corresponds to *lusus*.

It may be further observed that sports and seedlings sometimes become hereditary, and then take the name of race, or subrace. Sports and seedlings may be crossed, their half-breeds propagated by grafts, cuttings, etc., having all the appearance of sports. There results an almost inextricable complication, interesting in a physiological point of view, but which cannot possibly be subjected to a regular method of classification. Let us then do what we can to have the chief divisions of cultivated species assimilated to those of spontaneous ones. This would be gaining a great step, in the present state of things; and one of which horticulturists would be quite as sensible as botanists.

15. In the time of Linnæus, some naturalists of great merit blamed, and not without reason, the arbitrary manner in which he changed the names of existing genera. These

abuses are now legitimized by the custom of a century. There is what jurists term prescription. As to specific names, Linnæus being the first to use them, he has an undeniable right to those he has made—that of priority.

Article 15 must not be an impediment to quoting Tournefort, or any other, for a generic name made by him before Linnæus, and adopted by the last-named author, nor to quoting Lobel for a specific single-worded name adopted by Linnæus; but in cases where Linnæus, by an arbitrary act, has adopted other names, these must remain; this usurpation being, as it were, legitimized by habit and by general assent, and admitted, besides, on account of the evil consequences of a further change.

20. The final *-ales* for cohorts was first proposed in 1835 by Lindley.[1] That in *-ineæ*, employed somewhat later in several works, has the defect of wanting boldness, of having been already made use of for several Orders, and of being rather like a diminutive. In this point of view, it is more adapted to suborders than to agglomerations of Orders. The form in *-ales* is adopted by Messrs. Bentham and Hooker in the 'Genera Plantarum.'

Our proposed scheme formally recommended the final *-ales;* but the Committee not being unanimous on this point, asked the Congress not to restrict authors in this matter.

22. The derivation in *-aceæ* is in perfect conformity with the genius of the Latin tongue; but that in *-ineæ* was used in an analogous sense, as has been explained to me by an able professor of ancient tongues; *in*, in Latin radicals, being used in the same sense as *ac*. Euphony decided sometimes for one form, sometimes for another, and botanists have done the same.

Exceptions to the use of these two finals are warranted in some Orders by a long-standing custom, and sometimes by custom and euphony together. The leading principle of changing names as little as possible is applicable here. Added

[1] 'A Key to Botany.'

to this, in some large, very conspicuous, old Orders, bearing names of quite another form, the difficulty of choosing one genus among many hundreds, and making it, as it were, the standard of the Order, is a real obstacle. Why should *Leguminosæ* be called *Fabaceæ*, rather than *Trifoliaceæ* or *Astragalaceæ*, or by fifty other names? In thinking of most Orders, one of their genera frequently offers itself alone to the mind; but if we be thinking of *Leguminosæ*, a multitude immediately come to memory, not *Faba* rather than any other. The objection, that some *Leguminosæ* have no legumes, that certain *Compositæ* have isolated flowers, is not a very strong one, when compared to the advantage attached to old and well-known names. Fixity of names is a principle of superior order (Art. 3).

25. What is said of our patronymic names may be said equally of the names of genera or of sections. Certainly many names of persons are inconvenient, or even ridiculous, either because they have an adjective form with some particular meaning, or because they are difficult to pronounce, or for some other reason; but when they do exist, why change them? The aim of Science is not making names. Names are used by her to distinguish things. If a name is sufficiently distinct from others, that is the essential point.

Generic names are drawn from certain characters, from certain appearances, from localities, from the names of persons, from vulgar names, and even from combinations of letters that are quite arbitrary. All that is required of a name is that it shall lead neither to confusion nor to error. As long as this very general principle was overlooked, the rules laid down had the defect of being accepted by some and rejected by others.

It has sometimes happened that very distinct generic names have been made in honour of the same person, or of persons bearing similar names, when those names allowed it, as *Pittonia* and *Tournefortia* for Pitton de Tournefort, *Brownea* and *Brunonia* for Browne and Brown, etc. We think these names are to be preserved, for they cannot be confounded in an index; nor can they be so in conversation.

Assuredly if, since *Brownea* was made, there had appeared a botanist of the name of Brunon, no one would have criticized a genus called *Brunonia;* the generic name *Brunonia* is, consequently, admissible.

28. (3.) Nothing can be more inconvenient, in synonymy, than to have to explain why such a genus of such an author is not such another genus under the same name of the same author at another period. If this occurs in the same Order the difficulty is still greater, and confusion is to be apprehended.

28. (4.) By dedicating genera to grand personages who are strangers to botany, even to illustrious learned men who have taken no interest in natural sciences, you flatter persons who are oftentimes in no way obliged to you for your attention; you do not encourage young botanists, who are pleased at a distinction reserved for botanists; and, perchance, you may shock national or religious susceptibilities that have surely nothing to do with science. Thus the idea of naming the greatest of trees *Wellingtonia* is doubly to be regretted. In the first place, it has been found that the genus cannot be distinguished from *Sequoia,* which has necessarily been retained; and then the name of *Wellingtonia* has called forth a useless synonym—*Washingtonia;* in imitation of which every nation might have set to framing a name from that of its favourite hero.

28. (6.) We find it advantageous to have several genera of Ferns with names ending in *-pteris;* several among fossil plants in *-ites;* several of the Order of *Lauraceæ* in *-daphne,* etc.

29. (2.) Sectional names have sometimes been formed by the addition of *-oides* or *-opsis* to the name of the genus itself. Such a pleonasm may be considered rather weak, as the characters of the section being included in those of the genus, their resemblance is implied. To annul names of this kind would, however, offer more inconvenience than advantage; for, on the one hand, the names of sections are seldom quoted; and, on the other, by changing them, you create fresh synonyms.

29. (3.) Repeating the same sectional name in several genera gives rise to no great inconvenience, especially in different Orders, the name of a section not being quoted independently of that of the genus. It is nevertheless better to avoid so doing, on account of the embarrassment that it might occasion if, at a later period, the sections had to be made into genera.

33. This article has been added by the Congress, at the request of several members. When the last paragraph of Article 60 came afterwards to be discussed, the inconvenience of having to change all the specific names that have been made, up to this day, regardless of the rules there given, was not thought of. I think it would have been better merely to *recommend* observing the forms indicated in Article 33; or rather to have placed these rules under Article 36. I am inclined to believe there was, at that moment, some inattention on the part of the assembly, as sometimes happens in public bodies, and in cases of much more importance. As reporter, the blame must fall upon me before any one else. The spirit of our code lies in the maintenance of existing names, unless there be capital objections to it (Art. 16). Starting from this principle, and notwithstanding our vote, I confess that I should hardly dare change or modify a specific name, and especially a name of long standing, because it is formed in opposition to Article 33.

34 to 38. The numbers of these articles were different in the draft, on account of the addition of Article 33; but the ancient Art. 38 having been annexed to Art. 37, the numbers that follow, beginning by 39, have remained the same.

36. (6). By "nearly allied genus," I wished to imply a genus so nearly allied to another that it might one day be annexed to it. In fact, when this takes place, the duplicate specific names render changes obligatory, and complicate synonymy.

37. The article in our original text differed considerably from this. The manner of combining the names of the male and female parents, so as to designate their hybrid off-

spring, has been long since called into question; and this was one of the motives for which De Candolle (Physiol. Bot. p. 719), in 1832, was averse to that system of nomenclature. I fancied I could do no better than propose the mode recommended by Gærtner fil., in his classical work on cross fertilization ('Versuche über die Bastarderzeugung,' 1849, p. 600). There is frequently less difficulty in ascertaining the female parent; whence it seemed natural to mention it first. The name becomes thus a simple contraction of the common phrase: such a species fertilized by such another. On my arrival in Paris, several botanists, especially French and German, conversant with questions of hybridization, assured me that the contrary usage, that of mentioning the male parent first, had generally prevailed. As, after all, much of this is mere convention, I, and all of us, sided with the method in common use. On my return home, I wished to ascertain whether the authors, who have described a great many hybrid plants, had really followed the custom of placing the name of the male parent first. I was astonished to see that many of them had said nothing about it. Perhaps this may be attributed to their having been oftentimes ignorant of the real parentage of the hybrids, especially among wild plants. Some, perchance, may have supposed that the male parent ought to be the species with which the offspring had most points of resemblance; other botanists appear rather to suppose the contrary, and the degree of similitude is, besides, often questionable.

This showed the wisdom of another modification of my original text made by the Congress. It requires that the combination of the two names shall be only employed when the origin of *the hybrid has been experimentally demonstrated;* that is to say, when both parents are known. In all other cases, and these are undoubtedly the most numerous, the name must be analogous to ordinary specific names. This will tend to reduce the number of double names, of which the application is, moreover, inconvenient, and the resemblance too great to certain specific names belonging to plants that are not hybrid, such as *Lithospermum*

purpureo-cæruleum. In another point of view the motive which prompted this decision is an excellent one: too much cannot be done to oblige authors to be accurate; now, to assert that an offspring is of such or such a parentage, when no evidence can be produced, is anything but accuracy.

40. The system we recommend for cultivated plants (Art. 14 and 40) may be recapitulated as follows:—

(1.) Adopt for the principal modifications of species the names and forms in use for uncultivated species, that is, class subspecies, varieties and subvarieties according to importance; say, where possible, which are habitually hereditary (races, comparable to subspecies), which are less constantly so (subraces, varieties), which are rarely so (subvarieties): employ for all these degrees, as well as for their half-breeds, Latin adjectives, as in the case of ordinary species.

(2.) For modifications of a lower kind, the number of which is unlimited (seedlings, half-breeds of low degree, sports), take names from modern tongues, entirely different from Latin ones, such as horticulturists are in the habit of applying.

By means of this double combination the chief modifications, interesting to general natural history, are brought into connection with scientific forms, whilst at the same time the innumerable unimportant modifications produced in gardens bear distinctive names. In books there will be no longer a possibility of confounding them with botanical species. This is a necessary precaution; horticulturists, for the sake of abridging, being wont to drop the names intervening between the generic name and that of the seedling or sport. Instead of saying, *Brassica oleracea, acephala, vulgaris, viridis, Cavalier*, expressing thus completely the relations of the cavalier-cabbage with other species of *Brassica*, they must needs say Cavalier cabbage. If, instead of *Cavalier*, there was such a name as *grandis*, they would infallibly call it *Brassica grandis*, and it might then very well be taken for a spontaneous species.

This source of ambiguity must be avoided henceforth.

There are, however, already such unlucky names as *Rhododendron papilionaceum*, *Camellia planipetala*, etc., that seem as if they belonged to species, and that will insinuate themselves into botanical works. What they represent would be vainly sought either in nature or in herbaria. These garden products are factitious; let them be treated as such, and do not let us be exposed any more to confound plants of this kind with those that are spontaneous. Moreover, after a few years fashion changes. No one then cares anything about these innumerable horticultural creations that have been the delight of amateurs. Where are the two or three thousand Dahlias of this or that catalogue issued thirty years since? Most of them no longer exist; their names are forgotten. It is fortunate that the greater number were named after some celebrated General or lady, rather than by a Latin name that would have been preserved in books.

43. Communications made in public meetings, until they have been followed by the publication of a report, may be but imperfectly remembered. Commonly, the author is at liberty to make alterations in his manuscript before it is printed, or in the proofs. If the communication has been a verbal one, it may be modified when the author prepares it for the press. Persons with good memories, or who have taken notes, may find fault; the first publicity may consequently be accounted insufficient for conferring rights. Labels in public collections or in gardens may be transposed or removed at any moment. In all these cases the *fact* of publication is not sufficiently undeniable.[1]

45, 46. A specific name without that of the genus, a combination of a generic and a specific name without any kind of explanatory matter, are tantamount to nothing. They are words without meaning. They acquire value only from the day that some one gives them meaning by completing them. It may, perhaps, be said that some specific phrases are so short, so badly made out, that they are almost void of sense; that, in consequence, all such incomplete publications ought to be looked upon as null; else, if it was

[1] See Bentham, Address to the Linn. Soc. 1867.

thought proper to accept them, mere names ought to be accepted as well. It must be remarked, however, that these cases differ. The fact of the absence of any kind of character added to a name is a well-defined and positive fact, whereas the insufficiency of a description is something vague, and that can be called into question; besides, does it not sometimes occur that an apparently insignificant word is precisely that which allows you to hit upon a species?

47. (1.) It would be very useful to publish in journals and in bibliographical works the exact date of several books and plates, respecting which we are misled by the title-pages, or left in doubt on account of there being no date given. This is particularly the case with works published in numbers. In well-kept herbaria the labels of the collections that have been distributed bear the date of their reception, which generally indicates that of their distribution.

47. (3.) Publishing a name that cannot be adopted is uselessly throwing a synonym into circulation; at least, in indexes and dictionaries. Steudel's 'Nomenclator' would be as bulky again if all names existing in gardens, in herbaria or in travellers' notes, even those that are known to be of no value, were added to it. Names of this kind, when published, are *stillborn*. Why increase their number, unless in exceptional cases, when, for instance, an author requires that they should be made known?

48. For a long time it was the universal custom among botanists to quote for a combination of two names, generic and specific, the author who had first applied it to a species. Some zoologists have followed another method, recommended in 1842 by a committee consisting of Messrs. Strickland, Owen, etc., at the British Association (Report, § D.), but strongly combated from the beginning by M. Agassiz ('Nomenclator,' p. xxvi). Various botanists, MM. Fries, Fr. Schultz, Kirschleger, etc., having introduced the same method into botany, have likewise met with a brisk opposition, and the Publishing Committee of the Botanical Society of France even issued on the question an explanatory note, which produced some sensation. (Bull. 1860, p. 438.)

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The newly-proposed method consists in always quoting for a species the name of the author who first named and described it, laying aside, as it were, the name of the genus to which that species has been referred by the botanists that have followed. Among the advocates of this method, some are satisfied with quoting the author of the species, without any explanation whatsoever; others, especially zoologists, add (*sp.*) to the name, implying that the author has made the species only; and others, more conscientious, *sub* such a genus. Thus, *Matthiola tristis* (L. sub *Cheirantho*) implies the species that Linnæus named *Cheiranthus tristis*, and that another (the synonymy tells us that it was Brown) called *Matthiola tristis*. Let us take the method under this last form, evidently the most perfected, and let us see in what way it has been supported and attacked. We will afterwards give our own opinion.

The Committee of the British Association expressed itself in the following manner, through the medium of Mr. Strickland[1]:—"We conceive that the author who *first* describes and names a species which forms the groundwork of later generalizations, possesses a higher claim to have his name recorded than he who afterwards defines a genus which is found to embrace that species, or who may be the mere accidental means of bringing the generic and specific names into contact. By giving the authority for the *specific* name in preference to all others, the inquirer is referred *directly* to the original description, habitat, etc., of the species, and is at the same time reminded of the date of its discovery." According to this, *Muscicarpa crinita* L., since referred to the *genus Tyrannus*, ought to be indicated thus, *Tyrannus crinitus* L. (sp.), and, says a note at the foot of the page, *Tyrannus crinitus* L. would perhaps be preferable, from its brevity.

In the preface of his 'Nomenclator Zoologicus' (p. xxv), M. Agassiz strenuously resisted this. He first praises Linnæus for having said, "Nomen specificum nil est nisi distinctio specierum sub suo genere. Nulla dari potest differentia

[1] Report of the Brit. Assoc. for 1842, p. 120.

specifica ubi nullum genus." "This evidently shows," says M. Agassiz, "the importance that was attached by Linnæus to the *union* of the specific with the generic name. For no one to be harmed, as desired by the learned Englishmen, a new authority ought to be quoted for every new combination of names. Now, I do not hesitate saying that Linnæus would have formally rejected the expression *Tyrannus crinitus* L. (*sp.*). He had put this species in his genus *Muscicarpa,* and he would have kept it there as long as no doubts had arisen." . . . "The method proposed by the learned Englishmen," says again M. Agassiz, "suggests the idea that works undertaken with a view of constituting genera are less valuable than those undertaken for the sake of distinguishing species, which would not advance science." . . . "An excessive inconvenience would likewise result from this: we could not turn back to the original sources without much fastidious labour. How are we, in effect, to find out in Linnæus's works what he says of *Muscicarpa crinita,* without being told under what genus he has spoken of it ?[1] And how inextricable will the synonymy become if we have, some time afterwards, a *Tyrannus crinitus* L. (*sp.*), *according to Swainson,* and a *Tyrannus crinitus* L. (*sp.*), *according to another author,* who will have confounded some new species with the old *crinita !* We must then say, *Tyrannus crinitus, L.* (*sp.*) Swains., and *Tyrannus crinitus,* L. (*sp.*) x." Agassiz concludes by begging the authors of the new method, in behalf of the interests of science, which they have at heart as much as he has himself, "ut propositum deserant, schisma novum in scientiam non introducant, systema vero Linnæi simplicissimum illud, et erroribus babylonicæque in nomenclatura confusioni omnium minime obnoxium æquo animo

[1] The advocates of the method would perhaps say to this that Linnæan tables might be drawn up by *species.* Thus, at the word *crinitus* would be found references to all the pages of zoological and botanical works in which Linnæus has made a species bearing the name of *crinitus,* in much the same way as if, in a directory, individuals were to be classed under their Christian names. We admit that such a thing might be done, but it would be very inconvenient.

repetant." Mr. Shuttleworth, in a work on Malacology,[1] devotes a chapter to the support and development of the same ideas.

Let us now pass from zoologists to botanists, their opinion being to us of greater importance.

M. Kirschleger, in 1852, after mentioning the genera *Ranunculus* and *Batrachium*, in the preamble to his 'Flora of Alsace,' expresses himself as follows:—

"A very simple process has enabled us to render unto every one the honour that he is entitled to. To the author of the new genus detached from the old one we have left the merit (if there be any) of having raised an ancient subgenus to the rank of a genus, by appending his name to it. But we let the specific name be followed by that of the author who made it, or who first applied it, taking care to place it in a parenthesis: thus, *Cephalaria pilosa* (L. sub *Dipsaco*). We are aware that this may offend the conceit of some authors, but we like better not to fail in sentiments of justice and gratitude towards our elders."

In 1858, M. Questier, addressing himself to the Botanical Society of France (Bull., vol. v. p. 37), protested against this new method. He cites M. Billot as having written, *Mulgedium alpinum* L. Sp. 1117 (sub *Sonchus*); Less. Syn. 142, etc. "Are we not immediately shocked," says M. Questier, "to see the genus *Mulgedium* attributed to Linnæus? True it is that the corrective is to be found in the parenthesis, but did not the nomenclature in general use until now tell us the same thing more clearly, and with less risk of error? If now you wish to learn, and natural enough it is that you should, to whom belongs *Mulgedium alpinum*, you may perhaps guess, or perhaps, by dint of researches in books, if you have them, you may find out that it is to the author first quoted after the parenthesis. Suppose that, suitably to the works where the new system is followed, it be necessary to make an index, a list, a catalogue, a local flora, a synopsis, a compendium, in which little room can be given to the development of synonymy, is it not to be feared that both

[1] Shuttleworth, 'Notitiæ malacologicæ,' Heft i. Berne, 1856, p. 21.

parenthesis and anything that may follow will be neglected, and that we should merely have *Mulgedium alpinum* L., *Asterothrix Hispanica* Willd., etc.? What becomes then of the history of botany? Is it not altered and violated? And on whom can the fault be thrown but on those who have introduced this dangerous system?

M. Kirschleger again takes up the pen in 1860, and says, in the 'Bulletin de la Société Botanique' (vol. vii. p. 437) :—

"I believe in the necessity of restoring a multitude of species to their true authors and owners. Botanists write, *Cota altissima* Gay, and not Linnæus. What merit has M. Gay in this case? He has established the genus *Cota* (good or bad, no matter). Let him, then, enjoy the whole honour that the genus may shed upon him. But what pretensions can he have to the epithet *altissima*, which belongs to Linnæus or to Tournefort? It is of the *species* that I am speaking, not of the *genus*; and if I write, "Cota Gay; *altissima* L. (sub *Anthemide*)," I have at once given to each his due of justice, glory, and merit. If this notation be found too long,—in a catalogue, for instance,—the name of the author of the new genus may be left out, and that of the author of the species put into a parenthesis." M. Kirschleger adds ironically, "The orthodox notation has the immense advantage of encouraging authorities," by which he implies *mihis* and *nobises* added to long-standing names, or the satisfaction of seeing one's name in print.

The Publishing Committee of the Botanical Society answered in the following article of the 'Bulletin' (vol. vii. p. 438) :—

"The Committee[1] think it right to preserve without any alteration whatsoever in the Society's publications the notation to which M. Kirschleger gives the name of *orthodox* (that is, the ancient notation). This regular manner of indicating the name of the authors of Orders, genera, species, or varieties, consecrated by its adoption, in the two most

[1] This consisted of MM. Cosson, Duchartre, and Prillieux. M. de Schœnefeld, Secretary of the Society, took likewise an active part in the declaration of the Committee.

important works of systematic botany of this century, the 'Prodromus' of De Candolle and the 'Genera' of Endlicher, is at the same time the most simple, the shortest, and the clearest. Every other system, however equitable it may seem to be as regards the first author of each group of vegetable forms, will always have the great inconvenience of throwing a fresh element of doubt and confusion into the already too intricate labyrinth of synonymy.

"There is, moreover, according to our way of thinking, either error or exaggeration in the idea that this kind of signature habitually placed after the name of any group that has been established, restricted, extended, subdivided, or transposed, is solely a homage paid to the *merit* and to the *glory* of its author. The author's name thus placed is not only the acknowledgment of a right exercised by that author, it is also the recognition on his part of a responsibility that he is to undergo. The improvement of the natural system is (as Linnæus himself has said) the supreme aim of systematic botany. This being so, every change in taxonomy (creation, restriction, extension, subdivision, transposition of Orders, genera, species, or varieties) is true or false, good or bad. If it be good, it perfects the method in some way or other, and it is but just that the author should have the merit of it. If it be bad, the method is more or less impaired, and its author must suffer for it. In both cases the author's name, regularly placed, indicates, for each innovation, the share of merit and the share of responsibility belonging to each; nothing more, nothing less."

Finally, we may cite M. Boissier, who, in the preface recently published of the first volume of his 'Flora Orientalis,'[1] supports the new system. "Two motives," he says, "have led me to this mode of nomenclature, already adopted by several authors,—one of justice, the other of utility. There are, in effect, two kinds of characters in a plant; some, that are individual, constitute, as it were, the essence of the species, and allow of its being distinguished from neighbouring species; they are as constant as the species itself,

[1] One vol. 8vo, Geneva, 1867.

—they are termed specific characters. Then we have other characters that are collective, common to several species, frequently expressing some real relation between organized beings, when we have to do with natural genera, but also frequently understood in a very different way and in a very variable one by botanists, according to their particular turn of mind, and to the relative importance given to this relation; these are generic characters. It seems to me that in the name of a species, specific characters stand higher than generic ones, and that it is both just and logical to append as an authority to the specific name (which expresses the first and is not subject to change), the name of the author who first made the plant known, rather than that of the botanist who has understood its generic affinities in such or such a manner. This method relieves the memory and, at the same time, strengthens the immutability of names, while it allows serious botanists to make changes, if they think proper, in the classification of species for the sole benefit of science, without running the risk of being confounded with those authors who let themselves be led into interested innovations, in which vanity has a greater share than the love of truth."

After these quotations, which, for impartiality's sake, we have made *in extenso*, we have to give our own opinion, which has never varied on this question.

The custom of quoting an author's name immediately after the names of plants has not arisen, as some think, from a desire to do homage or to exercise an act of justice. Of course we must not be unjust in attributing, for instance, to an author a name he has not made, an idea that is not his own; but the process of quoting authors' names is, above all, an *orderly measure*. Its end is, 1st, to distinguish two or more genera, two or more species which have perhaps, unfortunately, received in science the same name; 2ndly, to facilitate the research of an exceedingly important detail: the date of the publication of a name, or of a combination of names, one generic, the other specific.

When it is wished to do homage to a botanist, a genus may be dedicated to him. If he is to be praised or to be

blamed on account of a species or a genus, his opinions may be mentioned and appreciated either in the text of a description, or by means of a parenthesis in the synonymy; but the citation of a name after the name or names belonging to a plant expresses in itself neither merit nor demerit. It is the mere laying down of a fact, namely, that such an author was the first to give such a name to a genus, or was the first to refer such a species to such a genus. In continuation it may be mentioned that another author has made such another combination of the specific and generic names. Each of them may be right or wrong; the question is not there. We want, before anything else, to know when a name has been made, or when a combination of names has been made, so as not to propose similar ones. Now to get at the date we must know who the author is. The date might have been given instead of the name, but this would not be so explicit, as two persons might, in the same year, accidentally give the same name to two different genera or to two different species. It is on this account that the custom of quoting the name of the author rather than the date has prevailed, this name being in itself no more than the expression of a fact.

But, it will be said, there are oftentimes two facts to set down; the species has been referred first to one genus, then to another. In this case, we think it is clearer to tell the things in succession: author A has made such a combination of names; author B another. Generally speaking, to be perfectly understood, each idea must be expressed in a distinct phrase or in a distinct member of a phrase. For two things to be clearly expressed, they must be separated. Linnæus made a species called *Cheiranthus tristis*, out of which Brown afterwards made *Matthiola tristis*. To express this it is more intelligible to say, *Cheiranthus tristis*, L., and then, in the next line, or after a stop, *Matthiola tristis*, Br., than to say, by way of condensation, *Matthiola tristis* (L., sub *Cheirantho*). With this over-contracted style,

"Brevis esse laboro, obscurus fio."

In the example above, it has been wished to say all in few

words, and a very important fact has been omitted in so doing, that of Brown's having created the combination *Matthiola tristis*, which allows you to turn back to the date, and to the motives which led Brown to refer the species to his new genus *Matthiola*. The expression L. sub *Cheirantho*, has a double and even a triple sense. It either conveys the sense that is intended, or signifies that Linnæus, in some note under the genus *Cheiranthus*, has spoken of the genus *Matthiola*, or, again, that he has mentioned a species called by him *Matthiola tristis*.

The indication under the form L. sub *Cheirantho*, offers, at any rate, this advantage, that every one knowing two words of Latin may translate it, and try to understand what it is intended to imply. Whereas if, instead of this, we have "*Matthiola tristis* L. (*sp.*)," the unversed will necessarily want to have explained to them that Linnæus did not make a *Matthiola tristis*, that the parenthesis signifies that he made the species only, and furthermore that 'sp.' is no allusion to Linnæus's classical work, 'Species Plantarum.' If we have "*Matthiola tristis* (L.), Brown," the parenthesis has first to be explained; and the reader, having learnt that Linnæus only made the specific name, wishes to know under what generic name. Finally, if it be "*Matthiola* Br.; *tristis* L.," the quotation, although very complicated, does not enlighten us the more as to the generic name under which the species is to be met with in Linnæus; nor does it tell us that, in creating the genus *Matthiola*, Brown referred to it the species *tristis*,—an essential point nevertheless as regards both precision and date.

The partisans of the proposed method ask for just dealing; but, in our opinion, they are mistaken in the application of this excellent principle.

Nothing can be more unjust than to attribute to Linnæus, for instance, a combination of names that he did not make, that he had no idea of, and that he would perhaps have blamed had he been acquainted with it. It may be said that the expression *Matthiola tristis* (L. sub *Cheirantho*) does not attribute the combination of names to Linnæus. That

is true when the sense of the parenthesis is perfectly understood, and when it is copied or uttered textually; but then there are ellipses and forced abbreviations, alluded to above by M. Questier. As the parentheses cannot be put entire into indexes, as they cannot be employed in conversation, nor in the text of discussions on species, they are omitted. There is a proof of this in the index of the 'Flora Orientalis' of M. Boissier, where we find *Matthiola tristis*, L.; *Gypsophila acerosa*, Boiss.; *Tunica prolifera*, L., etc.; although Linnæus never made a *Matthiola tristis*, nor a *Tunica prolifera*; nor M. Boissier a *Gypsophila acerosa*. So many inaccuracies, or perhaps injustices! For who can affirm that Linnæus would have approved of the genera *Matthiola* and *Tunica*, or that acknowledging the genera to be good, he would have referred there the above-named species?

If we hold, above all, to being just, we ought to do a great deal more than is proposed. We ought not to be looking out for the author who first named a genus or a species, or who first referred a species to a genus, but for the one who has given the best description of the genus or of the species, who has best made their affinities known, etc. When a botanist creates a perfectly natural genus on characters that had been before overlooked, it is to him that ought by right to be attributed all the species that are annexed to the genus at a later period, he having been the intelligent cause of what was done after him. Tell a scholar that such a plant is called *grata*, what does that teach him? Nothing. Tell him that it belongs to the genus *Clematis*; that will be going a great way, as he may then easily find the species in books, and he may perhaps know already to what Order the genus belongs. Tracing a variety to a species is oftentimes a work of more merit than was the description of the variety by the first who spoke of it. If merit is the chief point, it must be made out everywhere and in every case; and this being acknowledged once for all, then it would be time enough that the name of the author might be cited, even if it were necessary to turn as far back as Theophrastus; and if it happened that some one else afterwards rendered still

greater services, then the name of the genus or species would have to be transferred to another claimant. Interminable and contestable inquiries, impracticable for any one who has not given himself up specially to the history of science! The partisans of the new method cannot but be thoroughly averse to quoting the first author of a species when he has misunderstood it and described it wrong, as it frequently occurs. The fact is, that neither the new nor the old method are equal to do sufficient justice in the quotation of authors. But the old method is at least exact; all that is expected from the quotation of authors' names, it gives with precision. On this account we give it the preference.

Some persons are grieved to see the masters of science—Linnæus, for example—less often quoted, since certain genera established by them have been divided. "Think," says a Belgian botanist, "of the great name of Linnæus disappearing from our lists of species! Think of our no longer seeing the name of any plant followed by that famous L., that venerated sign," etc.[1] Our opinion is that Linnæus's ideas of species and genera were generally so just, that, after many divisions and subdivisions, we are obliged to return to them. Besides this, the reputation of a man does not depend upon the number of citations that are made of him. Theophrastus, Aristotle, Cæsalpinius, are rarely quoted, but are not the less considered very great naturalists. Among modern authors, some could be mentioned who are perhaps cited more often than Linnæus, but commonly for their blunders. Great botanists will always maintain their place in lists of synonyms, and especially in the history of science. The same may be said of great chemists, of great astronomers, though their names are not put after every terrestrial or celestial body that they have discovered.

It may be asserted that the method in common use encourages amateurs of glorification, such as are pleased to see their name in print. This is but a low view of the question. We have only to say that the very character of these ama-

[1] Crépin in Bull. Soc. Bot. de Belgique, iii. p. 223.

teurs must needs render them somewhat apprehensive of ridicule ; now, the making of names that are immediately to be reduced to the rank of synonyms, the letting oneself be called a *species-monger* by serious botanists,—is not this ridiculous enough, and more likely to touch self-love than any other process ?

We cannot, however, but admit that there are naturalists who have the weakness to demand that their names be affixed for ever to the species that they have described, or referred to their genera. Their desire is complied with by citing synonyms. To go further: to quote the name of the author who, you think, has improperly referred a species to a genus, is to encourage superficial people to describe and to name without troubling themselves about the genus,—that is, to overlook much more important characters than those of species, and to neglect the study of affinities.[1]

Another word on an argument brought forward by one of the last authors we have quoted.

It is to be regretted that genera should not all be self-evident, and that, by their not having been distinguished from the very first, we should frequently be obliged to hesitate, to create, or to overthrow such or such a genus, to move species from one to another, etc. But, may we ask, are species immutable ? Not in any way. They are diversely understood ; they are divided, they are united, etc., as are genera, perhaps more so than genera. The characters given of them in books are not determined. They have to be altered when a species is transferred to another genus, as it has then to be compared with other species. Of these two things, the species and the genus, neither of which unhappily is well determined, the genus is nevertheless to be considered as the stand-point, because the characters on which it is founded are more apparent, more important, and less variable, and because the number of genera being less considerable than that of species, we are nearer knowing all those that exist ; we mean, of course, all natural genera, for we do not allow of any others.

[1] Shuttleworth, l. c.

This discussion was again taken up in Congress (see Proceedings), but, when voting was resorted to, an immense majority stood in favour of the old system, as supported by us.

49. It is not quite correct to say that a genus or a species is of such an author, when the signification attributed to such groups by that author has been altered. It is on this account that Robert Brown, as well as several other authors after him, and still more recently Dr. Müller, of Argovia,[1] have considered as being made by them groups whose name was ancient,—of Linnæus, for instance, —but whose characters or composition they had sensibly modified. Thus R. Brown (Prodr. Fl. Novæ Holl., p. 494) gives a genus *Myosotis*, without any author's name (which signifies in this work that the genus is his own; see, p. 495, *Exarrhena*, and elsewhere), and adds, as a synonym, *Myosotidis* sp., L. In like manner, he makes a genus *Cynoglossum* (p. 495), which has for synonym *Cynoglossi* sp., L. He attributes *Convolvulus* to Jacquin (p. 482), with the synonym *Convolvuli* sp., L., because he takes the genus such as it was after being modified by Jacquin. In like manner, De Candolle (Prodr. iii. p. 121) attributes his genus *Rhexia* to Brown, because he comprehends it as Brown did; and as a synonym he gives *Rhexiæ* sp., L. Thus, too, he says *Crassula*, Haw. (see Prodr. iii. p. 383), and gives as a synonym *Crassulæ* sp., L. Dunal, in the 'Prodromus,' writes *Solanum*, Sendtn. Such examples could easily be multiplied.

It must be allowed that the process is rigorously exact. The genus *Myosotis* of Brown is not precisely that of Linnæus. Linnæus would, perhaps, not have understood it in the same way as Brown; consequently, it is neither exact nor proper to attribute it to him. On the other hand, this system has the great defect of acknowledging a multitude of genera bearing the same name, but scarcely differing one from another,—an encumbrance to synonymy, and still more so to indexes! In the course of fifty years or a century, botanists would be quite lost in the midst of so many names;

[1] In the *Euphorbiaceæ* of the 'Prodromus,' xv. sectio 2.

in *Borraginaceæ,* for example, there would be as many genera *Myosotis* or *Cynoglossum* as of authors having rather differently defined those genera. The same as regards species. Every author who has limited a species somewhat otherwise than his predecessors, so as to exclude or include a form more or a form less, may be considered to have destroyed the ancient species, and to have created another under the same name. In a few years the indication of authors would no longer signify anything, and works such as that of Steudel would be so full of similar names that there would be no clue to them. We must not pretend, then, to such absolute exactness. There is a simple means, and one in frequent use, of obtaining the greatest part of the desired precision; to this we cannot do better than resort. It consists in adding to the name of the author of the genus or of the species something indicating a restriction, an extension, or a modification of the primitive sense. The words *pro parte, reformatis characteribus, exclusis speciebus, exclusa varietate,* etc., which may be abridged, are quite sufficient to advise the reader of the change. By using them the writer is not exposed to affirm that a group is of such an author when it is not rigorously true. After all, what is of most importance is the name, because of the authenticity of that name, which must be justified by a date. You may change what you like in the genus *Xerotes*, Br., for example, but what cannot be changed is the fact of Brown's having made, in 1810, a genus under that name. In this point of view, which is the most important one, Brown must always be cited for *Xerotes.*

50. The publication of the name is the essential fact, for it is that which prevents the name being changed without good cause. He who publishes has acted the principal part. The traveller who gathered the plant, who perhaps gave it a provisional name in his herbarium, is no doubt indebted to the gratitude of botanists. He is oftentimes more deserving of this gratitude than the publisher of the name; it is on this account very proper to cite him for the native place or for the herbarium; but it is not he who gave publicity to the name. Had he been consulted, he might perhaps have published it under another name.

The consequences of the Article are not, however, so great as might be thought, many travellers or collectors *publishing* their names when they distribute their plants (Art. 42). Spruce, Kotschy, Wallich, and a number of others, have published their names by means of labels or catalogues, which are to be cited. Others have put no names, or have not distributed their plants; in those cases, the only names to be cited are those of the authors who have published them. It is proper, for instance, to cite Spruce for a species named and published by him, and then described by Bentham, and to quote Bentham for one of Hartweg's plants, distributed by him without a name, but afterwards named by Bentham. To act otherwise would be incorrect, and, as regards ancient travellers, it would not be equitable. Commerson, for instance, has left names of plants in herbaria, without publishing them. Those who publish them now cannot conscientiously attribute them to Commerson; for, botany having undergone many changes since the time of that zealous collector, he would not, in the present day, give his plants the names he gave them formerly; and who knows whether he himself had not already discovered that some of his names were erroneous?

51. A rather common error, but not the less to be regretted, is to quote, as the author of a sectional name, the botanist who applied that same name to a genus, or *vice versâ;* or, again, to quote as the author of a species him who had named the variety that is raised to that rank. Through this negligence the opinion of the original author is wrongly represented, and the reader is deceived as to the date of the section or of the genus, or of the collective names of the species or varieties.

52. The rule laid down was followed by Linnæus, Jussieu, De Candolle, Endlicher, Steudel, and all other botanists till of late years. Many botanists have now, for some time, got into the habit of abridging by the suppression of vowels, even in the first syllable, the result being—1st, that many of these abbreviations are unintelligible; 2ndly, that if it be required to search for the name in an alphabetical list of

authors, or in the classical work of Pritzel, which comprises all botanists anterior to 1841, one is obliged to read over all the names that begin by the first letter of the abbreviation, there being frequent hesitation between this or that, or even impossibility to arrive at finding out the true one.

Here are, for instance, some unguessable abbreviations taken from recent works:[1]—

Ktzsch.	H. Bn.	Brm.
Brghtw.	Brn.	Btt.
HK.	Hsch.	Spng.

We know by experience that in certain works Örd. signifies Örsted; that Bth. signifies Bentham, rather than Booth; that Sz. signifies Schultz rather than Steetz or Szovics; but that a young botanist should know this by intuition is out of the question.

If, at least, the last letter of the name were to be placed above, as Ör^{d}, we should understand the abbreviation much better; but between *r* and *d*, in Örd., you may imagine that there are several vowels or diphthongs, and it may be thought there are more vowels after the *d*.

In an abbreviation such as Krst. (for Karsten?), nothing can lead you to suppose that there is a vowel after the first letter; it might, with just as much probability, be after the second.

What renders this mode of abbreviation so enigmatical, is the great number of vowels or diphthongs employed in different tongues. We are not only obliged to look among Latin names, or among those belonging to Latin tongues, but also among German, Danish, Hungarian, Bohemian, Russian names, etc., which have different letters and different combinations of vowels. If you write Hook. for Hooker, any beginner will understand you; the signification will easily be found by referring to Pritzel, as few botanists' names begin by those four letters. But only

[1] We could easily say what works and at what pages, but out of respect for the authors, we think the citation of these hieroglyphics quite sufficient.

let an innovator take it into his head to write Hkr, nothing is to prevent you supposing that the name begins by one of the following combinations, even laying aside some of the most unlikely:—Ha, Hæ, Hä, He, Hi, Ho, Hö, Hœ, Hu, Hü, Hy, Haa, Hae, Hai, Hao, Hau, Hea, Hee, Hei, Heo, Heu, Hey, Hii, Hia, Hie, Hiæ, Hio, Hiœ, Hiu, Hoo, Hoa, Hoe, Hoi, Hou, Hoy, Hua, Huæ, Hue, Hui, Huu, Huy, Hya, Hyæ, Hye, Hyo, Hyö, Hyu (total 47). Between the *k* and the *r*, you may hesitate between the same vowels; and finally after the *r*, there might likewise be found some one of the 47 kinds of vowels or diphthongs. If, however, there is no stop after the *r* it will be thought that the name ends there. $47 \times 47 = 2209$. There may then be 2209 names hidden under the abbreviation Hkr. The process of quoting completely the first syllable and the beginning of the second is decidedly the clearest, and is not sensibly longer.

In a compound abbreviation, the omission of a stop where letters are left out is always a fault; to put, for instance, RBr., for Robert Brown; HBK., for Humboldt, Bonpland, Kunth.

Some defective abbreviations introduced into books have become so common that there is hardly any one unacquainted with them; it would, consequently, be both difficult and useless to give them up. The name I bear, for example, ought to be abridged either DeC., or D.C., or more regularly Cand., instead of DC. which has prevailed. If any one were to think of abbreviating Du Petit-Thouars by DP., he would not be understood.

The rules of abbreviation, as well as most others, suffer exceptions which we are obliged to admit for the sake of perspicuity, or of avoiding certain inconveniences that might offer. It is customary, for instance, to abridge the word Saint by S^t, Sanctus by S^{us}; consequently, it is natural that the name of Saint-Hilaire should be abridged by S^t Hil. When a name has been abridged thousands of times in an exceptional manner, beginners must be made acquainted with it. Using a correct method would not undo what already exists, and the same author would thus be designated in two dif-

ferent ways, which had better be avoided. There are also some scarce combinations of letters which would render an abbreviation incommodious and almost null, were the rule to be followed strictly. The name of Decaisne, for instance, would not be sufficiently designated by Dec.; while it is very clearly so if you write Decsne, especially if in the series of synonyms care is taken not to put a stop after the final *e*. In effect, a very frequent cause of obscurity in books is the typographical fault of putting a stop after the final letter of a name, when putting one is not rendered obligatory by the termination of a phrase, or by the suppression of letters. Compositors in printing-offices are not aware that the names of Re, Blume, Don, Ker, Blytt and others are not abridged; that in Michx the *x* is the final letter; consequently, that those names ought not to be followed by a stop implying an abbreviation. Some botanists abridge when it is unnecessary. Blume does not take up more place in a text than Blum.; and very little time is gained by skipping a letter or two in names of a single syllable.

Precise rules have sometimes been proposed for abbreviations, which would be identical were they to be made in the ordinary form; for instance, in the case of two botanists of the same family, or bearing the same name, or names beginning by the same letters; but there can be no harm in letting each author do what he pleases in each particular case. That Gærtner son, or *filius*, should be abridged by Gærtn. f., and Jussieu son, by Adr. Juss., is tolerably indifferent, both abbreviations being clear enough. If, to distinguish Michaux from Micheli, you put Michx, or better, Mich^{x}; if, to avoid the hesitation that might result from the many names that begin by Reich, you abridge Reichenbach by Reichb.; if, to prevent Marschall von Bieberstein from being confounded with other Marschalls, it be indicated by M. Bieb. or even by Bieb.,—something is gained in the way of clearness, and the value of the principal rule is in no way lessened.

54. According to Linnæus, the name of a genus that has been divided must remain with the most common species,

or with that which is officinal (*vulgatissimæ et officinali*),—an ambiguous expression in all cases where there is one of the species that is very common and another officinal. Subsequent authors say that, in general, the name ought to be left to the oldest species, to those that constitute the most ancient type, etc.; but it is impossible not to take into consideration the relative number of the species. *Convolvulus sepium* and *Erica vulgaris* were very common species, and very anciently named, when Brown made out of one of them his genus *Calystegia;* and De Candolle, out of the other, his genus *Calluna.* In so doing they surely acted more wisely than if they had changed the names of a hundred *Convolvuli* and two hundred *Ericæ.*

57, 58. The contents of these Articles will appear new to some botanists, at least so far as modifications of species are concerned. They are, however, useful for preventing the multiplication of names, as well as for assisting the memory in cases where there is a change of place or of rank. Several exact authors have observed them for some time.

59. May an author change a name that he regrets having published? Yes, but only in the cases in which any other botanist may do so. In short, publication is a fact that the author cannot annul.

See also the Commentary on Article 25.

60. (1.) We say *in the vegetable kingdom;* thus, according to us, the same name may be employed in both kingdoms. This is contrary to one of the rules of Linnæus (Phil. Bot. 230); but in this question we must turn back to the fundamental principle (Art. 3) of every nomenclature, which is to avoid error, ambiguity, confusion. Is it possible now for confusion to arise from a group of plants bearing the same name as a group of animals? Evidently not. If a group of plants was by chance to receive the name of Psittacus, nobody would ever take the species for parrots. Strictly speaking, there might be some doubts in certain obscure categories of beings which have been rejected from one kingdom to another. But the only conclusion to be drawn from this is that, in these doubtful classes, a naturalist does well to avoid names that are common to the two kingdoms.

60. (3.) Applies to names that are flagrantly, completely false, whose falsity no interpretation can ameliorate; for instance, in the case of a species called *annua*, but which is perennial, or of a species bearing the name of a country where it does not grow, of a genus whose name expresses a character that is wanting in all, or almost all the species, especially a character opposed to those which distinguish the genus from neighbouring ones. The inconvenience of changing names is, however, so evident, that the application of this rule is avoided wherever it is possible. For instance, *Plantago major* is not the largest of all, but it is larger than such a one;—that is enough; *Circæa Lutetiana* is found over the greater part of Europe, but it grows round about Paris;—that is enough; all *Chrysanthema* have not yellow flowers, but almost all have;—that is enough. Many species of the Andes, or of Himalaya, have been called *alpina*, but the word 'alps' has been improperly taken in the sense of lofty mountains; so *alpina* may pass, etc.

60. (4.) We may hardly think ourselves authorized to do away with names of sections made out of a personal name with *eu*, *-oides* or *-opsis*, notwithstanding names of persons being Latinized and not *Grecified*. They are not of Latin origin; that must be considered sufficient, as we must avoid changing names: only an attentive botanist will avoid making such uncouth names. *Eu* placed before a genuine Latin name is a barbarism; *-ides* or *-opsis* at the end of the word are scarcely more tolerable. I do not know whether I would dare change those faulty names where they exist, because of the essential principles of Article 3, second paragraph, and of Article 16; I hope, at any rate, I have none to reproach myself with. In botany we ought to aim at some correctness in Greek and Latin names, and try to avoid making such ill-constructed words as *millimetres*, *centimetres*, *bureaucracy*, *panslavism*, *pan-Anglican*, etc., of our modern languages, and which all have the defect alluded to.

60. (5.) See the commentary on Article 33.

66. Changing the first letters, especially the first letter of a name, may occasion much inconvenience, on account of

tables, catalogues, and dictionaries arranged according to alphabetical order. It is very inconvenient, for instance, that several generic names beginning by *E* should have been altered into *He,* on account of a hard accent in Greek. Such names must be looked for in two different parts of the tables. Greek accents varying with the dialect, we do not see why we should be more rigorous than the Greeks themselves. Changing names that are well known under a certain autograph offers inconvenience likewise. At the Botanical Congress held in London in 1866, it was proposed to modify the name of Cinchona on the ground that the genus had been dedicated to Countess Chinchon, but the majority of the botanists present were of opinion that the already established custom was to be maintained. *Gundelia* is very far from Gundelsheimer; but as ancient botanists have allowed themselves this licence, which is now consecrated by a hundred years' habitual use, why change it? Purists have only to forget Gundelsheimer, and to accept the name of *Gundelia* for an arbitrary one. In these kinds of questions, it must be borne in mind, first, that the fixity of names is of superior importance; secondly, that a botanist has the right to construct a name in any way he pleases, something in the form of a man's name, for instance.

Vulgar names, above all in barbarous tongues, are frequently uncertain, and the manner of spelling them is oftentimes doubtful. When turned into scientific names, nothing can be easier than to subject them to alteration under pretence of rigorous precision. *Coffea,* for instance, might become *Covea, Cavea, Caufea,* etc., according to the idea you may have of the spelling of the Arab word. It frequently happens that the same property exists in several nearly allied species, whence the same name has been given to them by different tribes. A botanist attributes the name to one of those species; no matter, else we might be perpetually contending and changing.

67. It is desirable that the use of Latin should be maintained in botany for descriptions, and more especially for

names. These, like our proper names, are to serve in all languages. No doubt some names of cultivated plants, or of such as are very well known, are found more current in common language than botanical names; and it would be ridiculous, for instance, in an English text, always to say 'quercus' instead of 'oak.' Laying aside such cases, nothing can be more convenient than Latin names, used with or without some slight modification. The public adopts them promptly, even if they be eccentric. It is a matter of habit. No one can object to names such as Fuchsia, Rhododendron, etc., now in common use in all countries.

There are in every language names of plants the meaning of which is not very precise, or which are so seldom used, that the greater part of the inhabitants of the country are unacquainted with them. It is best not to make use of them in books, but rather to habituate the public to names taken from the universal tongue.

68. With still greater reason ought the fabrication of names termed vulgar names, totally different from Latin ones, to be proscribed. The public to whom they are addressed derive no advantage from them, because they are novelties. Lindley's work, 'The Vegetable Kingdom,' would have been better relished in England had not the author introduced into it so many new English names, that are to be found in no dictionary, and that do not preclude the necessity of learning with what Latin names they are synonymous. A tolerable idea may be given of the danger of too great a multiplicity of vulgar names, by imagining what geography would be, or, for instance, the Post-office administration, supposing every town had a totally different name in every language.

Sexual organs
Stamen
Anther
Stigma
Front view
Side view
Section of flower before the operation: the mass of pollen in the anther.
Section of flower after the operation: the mass of pollen in the stigma.
First part of operation
Second part of operation
Operation of fertilisation

ORGANS AND FERTILISATION OF THE VANILLA

VANILLA:

ITS CULTIVATION IN INDIA

BY

J. E. O'CONNOR.

REVISED EDITION.

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VANILLA:

ITS CULTIVATION IN INDIA.

EPIDENDRUM VANILLA, the fruit of which is the vanilla of commerce, is a creeping plant belonging to the family of orchids. It is a native of Mexico and other warm regions of Central and Southern America, and it is said that a species is also indigenous to India. From America the plant has been introduced into various other countries where it has thriven and flourished. It loves heat, chequered shade, and moisture, and its creeping stem should have for its support a tree if possible, or a post or pillar with a rough surface giving a firm hold to the roots thrown out at the joints of the knotty stem. Some authorities recommend that it should be trained on horizontal espaliers running parallel to the soil and close to it, so that the roots thrown out at the joints of the stem may be able to seek nourishment from the earth. There are several known varieties of the plant, two of which, *Vanilla planifolia* and *Vanilla aromatica*, form the main source of the vanilla known to the trade. The pods, which are the part of the plant employed, vary, according to the conditions under which the plant is grown, from 5½ to about 10 inches in length.

Vanilla first became well known in Europe about the year 1720, and has always been used solely, by confectioners and tobacconists, as a flavouring essence and aromatic, possessing stimulant and stomachic qualities. It serves to flavour snuff and cigars, chocolate, ices, and confectionery of various kinds; and the trade therefore, depending as it does in some degree upon caprices of fashion, is always to a small extent uncertain and speculative, prices being subject to considerable fluctuation though as a matter of fact it has seldom if ever been anything but

very profitable, the demand increasing with the progress of refinement and luxury in greater proportion than the supply. Vanilla has such an exquisite aroma that it is not probable that its use for these purposes will diminish, and the trade may be considered perfectly safe. It was stated in the first edition of this pamphlet that the pods yield a fine brown colour, and had come into demand for dyeing purposes in Germany ; and it was added that this employment of the article for industrial purposes, though, by reason of the high price, it would necessarily be limited, would probably give a strength and fixity to the trade which would render it tolerably independent of possible changes of mode. More recent information, however, shews that this statement must be modified. It is true that an attempt was made to utilise the pod as a dye, but apparently without success. It is stated indeed that the pods have been recently brought into use at Lyons as a mordant in dyeing the more valuable qualities of silk, but I have no trustworthy information on the subject. The rapidly increasing consumption of vanilla followed after the Paris Exhibition of 1867 in consequence of a sale to foreigners at a very low price of a lot of 6,000 kilos. of vanilla. The taste for this flavouring essence has since then spread amongst people who had never heard of it before, and who now cannot do without it. In Russia it is extensively used to flavour spirits and inferior wines. Of the vanilla grown in Réunion a large portion is exported to Germany, the trade having sprung up after the war of 1870-71. The colonists declare, according to Consul Segrave, that this trade is entirely the result of the taste contracted by the Germans for French confectionery during their stay in France. It is estimated that the present production might be quadrupled without any appreciable effect on prices.

There was some talk last year, shortly after the publication of the first edition of this pamphlet, regarding the discovery of an artificial substitute for vanilla in a substance extracted from pine sap, to which the name of coniferin was applied. The report of this discovery formed the subject of paragraphs in a Calcutta journal which without reasonable ground for its opposition set its face against my suggestions for the cultivation of vanilla in Bengal. It was pointed out by the newspaper in question that those

who adopted my suggestions would probably have their trouble for their pains, inasmuch as no person would buy the expensive pods produced by the plant when they could obtain a much cheaper and equally aromatic chemical product. Those who wrote thus omitted to take into consideration, *1st*, that the present high prices of vanilla are the effect of an insufficient supply; *2nd*, that even if prices are very materially lowered, the plant, occupying as it does but little space, and having regard to the conditions under which it may be cultivated, will still be highly profitable; *3rd*, that the people who consume vanilla are mainly of the comfortable classes who can afford and will always prefer paying a comparatively high price for a genuine article, rather than consume some curiously compounded chemical product. In the purchase of necessities, the bulk of the purchasers being poor, cheapness is an object: in the purchase of luxuries cheapness is not an object to the purchasing class. When prices attain a limit beyond which they do not care to go, they cease purchasing—that is all. This limit will never be attained in the case of vanilla. And *4th* and lastly, those who set themselves against the views I ventured to put forth, forgot to inform themselves of the prospects of the discovery to which they referred. As the invention has died a natural death and is heard of no more, it may be classed among those efforts of ingenuity, more curious than useful, of which two of the most famous are the American manufactures of wooden nutmegs and petroleum champagne.

It may be of some interest to exhibit here the figures of the importation of vanilla into France and those of the internal consumption and re-export. They are as follow:—

Year.	Importations from			Total.	Home consumption.	Exportation from France.
	Mexico.	Réunion.	Mauritius and other countries.			
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
1870	6,402	10,323	6,300	14,025	11,863	2,162
1871	6,893	18,263	4,000	29,154	16,186	12,968
1872	1,938	15,506	9,000	26,444	10,623	15,821
1873	6,690	13,773	8,000	28,463	12,603	15,860
1874	2,229	22,802	10,000	35,031	16,065	18,966

Note.—A kilo. is equal to about 2 lbs. 3 oz.

The propagation and cultivation of this plant are so easy and the results so profitable that it is desirable to introduce it into India wherever it will thrive. The stock at present brought to the European market is derived from Mexico, Venezuela, and Réunion, and an inferior kind from Brazil. In Réunion the culture is comparatively new, having spread largely only after the failure of the sugar-cane, between 1850 and 1856. In 1851 the production amounted to 30 kilos. valued at 1,500 francs (£60); in 1857, 1,917 kilos. were exported to France; in 1858, 2,841 kilos.; in 1871, nearly 40,000 lb. were exported, amounting in value to nearly £100,000; in 1872, the crop was severely injured by a destructive cyclone and the value of the exports did not exceed £50,000. In a report by M. Delteil, published in the *Moniteur de la Réunion* of the 12th September last, it was stated that the island then contained more than a million plants of vanilla, capable of producing this year or next year nearly 100,000 kilos. of prepared vanilla for the European market. In 1874 the colony exported for the nine months ending September about 18,000 kilos. of vanilla, the price of which on the spot ranged from 90 to 105 francs per kilo. for ordinary kinds to 155 to 175 francs per kilo. for fine kinds. As the plant not only yields fine returns pecuniarily, but is an ornament to the garden, a very large proportion of the population are engaged in its cultivation, plants being found in every garden; and this fine industry is now, with coffee, the mainstay of the island. Captain Lowther, writing to the Agri-Horticultural Society of India in 1861, mentioned a well-managed plantation of *one acre* in extent, being the enclosure of a small villa in St. Denis, which yielded the family inhabiting it, in one season, as much as 15,000 francs, or 6,000 rupees. Captain Lowther added with perfect truth that nothing could be more simple or inexpensive than this branch of cultivation.

It seems strange that the cultivation of a plant which occupies so little space, and the fruit of which is so valuable, should not have taken root in Bengal, where the climate is certainly favourable to it. Experiments have been made from time to time, it is true, but, conducted in a desultory, unsystematic sort of way, they have given no

results; and though the plant has been known here for forty years, it is still only to be found in a few gardens in and about Calcutta, grown for ornament, not for use. The plant was introduced in 1835, specimens having been sent from England to the Botanical Gardens, where they grew for a time, flowered, but did not set fruit (probably owing to ignorance of the need for artificial fertilization), and were then allowed to die out. Later, Dr. Mouat introduced plants from Mauritius, and these fruited freely. From these plants others were propagated in the garden of the Agricultural and Horticultural Society, and the reports of local confectioners on the pods produced in 1855 were the reverse of discouraging. Messrs. Spence, confectioners and hotel-keepers, only objected that they did not consider the vanilla had such a strong flavour as that imparted by the imported vanilla. Messrs. D. Wilson & Co., also confectioners and hotel-keepers, were of opinion that the pods were nearly equal to those they obtained from France: "we are of opinion that it might be brought to compete with the foreign produce. We think it not quite so full flavoured as the foreign, which may probably have arisen from exposure."

The following report was made on pods sent in the same year to London: "The vanilla pods have been in the hands of one of our oldest and largest firms as confectioners. They report as follows: 'We have used the vanilla sent, and find the strength good. The pods were very small, and were much dried, in consequence of being packed in wadding instead of being wrapped in tinfoil and packed in the tin case. We consider it of good quality. To make it of commercial value, the pods should be long and of a very dark brown colour, almost approaching to black. They should also be moist, and if properly ripened before being packed, they become after a time covered with minute acicular crystals which much add to their appearance and marketable value. The value of the vanilla sent is about 50*s.* per pound. Had it been fine (say one-half longer) and in the condition mentioned above, it would realize from 80*s.* to 90*s.* per pound. The present price of vanilla is about 20*s.* per pound above the average value."

In a later report of the same year, Messrs. D. Wilson & Co.

wrote: "We have tried the vanilla repeatedly, and are happy to say that it is better than that you sent us on a former occasion,—that is, it is stronger and makes a very good ice; but we are obliged to use more of it than would be necessary in our imported vanilla, consequently in some cases the colour is affected. The pod requires to be better dried before being put away for keeping. Some of those sent us became mouldy and useless. We think that five of the imported pods are equal in strength to eight of those we have tried from you." Considering the novelty of the cultivation and the inexperience of the growers in the matter of preparing the pods for the market, these reports were very hopeful. Why the cultivation was abandoned I cannot say. No explanation is given, but it is probable that some of those changes to which Anglo-Indian society is subject caused the matter to be neglected by the manager of the garden for something else; and the cyclone of 1864, by destroying the best of the plants, seems to have given a final and fatal blow to the Society's little attempts to introduce a new industry. Later, Mr. W. Money opened a vanilla plantation on the Sibpur side of the Hooghly, but he was obliged to leave the country, the estate was sold, and the purchaser knew nothing or cared nothing for vanilla. Plants were also put down in two or three places in the Terai below Darjeeling, but they seem to have all disappeared.

The only reason now urged against the cultivation of vanilla in Bengal, putting aside the general objection of which I have already disposed, is that the cold of winter is too severe for it, causing the fruit to fall, and in some cases killing the plant. This explanation, however, is insufficient. It has been abundantly proved that if properly sheltered (and the common pânwaris, so well known in Bengal, afford a cheap and efficient shelter) the vanilla will thrive and perfect its fruit in Bengal. Moreover, we shall find further on that vanilla flourishes at Bangalore, where the winter temperature is lower than that of Calcutta, the cold weather also lasting longer. Thus in Bangalore the average temperature is

In September	72·0° Fahr.
„ October	71·5° „

In November	71·5°	Fahr.
„ December	67·0°	„
„ January	69·0°	„

while in Calcutta it is

In November	76·6°	„
„ December	70·3°	„
„ January	69·2°	„

September and October, which are cool months in Bangalore, are disagreeably hot in Calcutta.

Vanilla even thrives at Ootacamund, where it is needless to say the winter temperature is severer than at either Bangalore or Calcutta. I find from a recent report that Mr. Jamieson, Superintendent of the Botanical Gardens, has planted out large quantities of vanilla around rocks and the stems of trees, where they are making rapid growth. The plants flower freely, and Mr. Jamieson is confident that if the flowers were fertilized, fruit would be obtained in abundance. I do not find that the attempt has been made. If it has not, it would be desirable to try the operation and note the results.

The remarks made by Dr. George Henderson, when acting as Superintendent of the Calcutta Botanical Gardens, merit special attention :* "Altogether the history of the attempt to introduce vanilla culture into Bengal is a most disappointing and discouraging one. Here is a plant as readily propagated as a willow, which thrives everywhere it has been tried, and the fruit of which is almost worth its weight in silver, yet not a single native or European, as far as I am aware, has had the enterprise to continue the cultivation even experimentally. Some years ago a European gentleman near this had many acres of vanilla, but he had soon to leave the country, and the estate being sold, the vanilla culture was given up. I have often thought that some means might be devised for getting the natives of the country to carry out such experiments by the offer of prizes for the best result, these to be given at exhibitions frequently held. I certainly think that Government should continue the experimental culture of vanilla both in these gardens and at Rungbee; but to do any good it must be taken up as systematically as tea, chinchona, or ipecacuanha,

* Letter to the Government of Bengal, dated 25th September 1873.

and a small additional establishment be allowed. Before receiving this correspondence, I had commenced to multiply, as rapidly as possible, all the species of vanilla growing in this garden. It is to be regretted that an acre of ground, with a separate establishment, was not devoted to this plant when originally introduced; and if it is to be again taken up and fairly tried, the experiment should be done more thoroughly and on a larger scale than before, and, to attract public attention, the result should be regularly reported and published in the Supplement to the Gazette."

The real reason of the discontinuance of the experiments I take to be the ignorance of the process of fertilization of the flowers. In its natural habitat in the forests of America the flowers are fertilized by insects which do not exist in this country, and therefore artificial fertilization must be resorted to. The process is simple, but it must be done at the right time, or no results ensue; and it is tolerably certain that the operation having been entrusted in most cases to native mâlis, over whom no proper supervision was exercised, was improperly done, or done too late, or not done at all, and that disgust and disappointment caused most of those who had undertaken the cultivation in a *dilettante* sort of way to give it up. The history of the attempts to introduce improved agricultural practice and new industries in India is full of similar incidents, and the consequent loss to the country has been incalculable.

Turning from the experiments at Calcutta, let us see what has been done at Bangalore. Here the cultivation was taken up recently in the Lál Bágh, under the supervision of Colonel Puckle, who takes much personal interest in the experiment. In 1873 he sent half a pound of pods to a firm in Madras, who obtained for him the following encouraging report from London: "Sample resembles some imported from Mauritius some years ago. Evidently hurried in curing, causing all the beans to split, which is objectionable, because the small seeds escape without the moisture being sufficiently got rid of. In the present scarcity sample would realise 40*s.* per pound; with more care in preparation a good commercial article could be obtained, for the crystallization proves the bean to be well matured." Colonel Puckle found the culture of the plant very easy,

and the flowers were fertilised freely. He raised some hundreds of cuttings for distribution throughout and outside the province.

Mr. New, the late Manager of the garden, thus described the method of culture adopted:

"The vanilla succeeds well in the Lál Bágh at Bangalore, where it is planted in a mixture of leaf-mould and sand, and trained to thin stone pillars placed three feet apart and seven feet in height, with cross pieces on the top to form a lattice-work for the branches to cling to. A chequered shade is obtained from adjacent mangoe-trees, which is essential, for if the vanilla plant be exposed to the full rays of the sun, it droops and soon gets sickly. Trees with rough barks will also serve as supports for the plant, the mangoe being one of the best. It usually flowers the third year from planting, but does not produce fruit unless artificially fertilized."

The following is the account of the cultivation given by Mr. Cameron, the present Superintendent, in a letter dated the 16th March last:—

"*1st.*—The vanilla aromatica succeeds well in the Government Garden; it is growing in a mixture of leaf-mould and sand, and trained to thin stone pillars placed three feet apart and seven feet in height, with cross pieces on the top to form a lattice-work for the plants to cling to: this mode of training has been adopted more for convenience in fertilizing and otherwise dealing with the plants, than that any essential good can be obtained from a stone support. In my opinion, trees with a rough bark, such as the mangoe, averrhoa, or jambosa, afford the most natural support for vanilla, and if the plants are carefully treated, the pods will be larger. As a proof of this statement, I found that some of the pods which were gathered this year from plants trained on the adjacent mangoe-trees were much finer than those under immediate cultivation.

"A chequered shade is essential: when exposed to the full rays of the sun the vanilla soon becomes sickly. The plants require to be well watered when the ground becomes quite dry about the roots, but only when such is the case, as nothing will kill them sooner than stagnant moisture. When planting in low situations the ground should be slightly raised above the surrounding level, with sandy soil and gravel, to permit superfluous water to run off. Ordinary sized cuttings when rooted and planted out, usually

produce flowers the third year from planting. But another sort of cutting which may be layered at once where it is intended to grow—*viz.*, a portion of a young branch or shoot, having from four to eight or more joints—will produce flowers in eighteen months or two years.

"The proper way to fertilize the flower is easily acquired with a little practice. Natural fecundation is prevented by means of a thin skin which covers the stigma; this should be gently raised with a small piece of bamboo sharpened and nicely rounded at the points; introduce the pollen, and let down the covering again. The operation should take place in the mornings from 8 to 10 o'clock; in this country the flowers generally close after that time until the evening.

"*2nd.*—The crop of fruit was very good this year, but the present plantation is not sufficiently extensive to be of much commercial value to Government. The total weight after being dried and packed is only 8 lbs."

In a later report Colonel Puckle stated that the mangoe trees were found to give too much shade, but that judicious pruning remedied this defect. "We find the vanilla will succeed in any place sheltered from the wind and sun. It is not necessary that it should be planted against a mangoe or any other tree, or upon stone supports, as detailed in the marginal report [*i. e.*, Mr. New's memorandum quoted above]. All that is required for a vigorous development of the plant is that some sheltered spot should be selected, and supports raised for it to climb over in any convenient way, and in such a manner that the sun's rays shall throw only a grateful chequered light upon it. Under such treatment it pushes out rootlets from each joint, like the common ivy, and can easily be propagated by cuttings raised in the usual way. This is a quicker method generally than layering it, for, with ordinary care, the cuttings strike most freely."

Colonel Puckle has not yet been able to carry out with entire success the very nice process of preparing the pods for market—a process which requires great care and judgment, combined with experience. But he has made considerable progress, as will be seen from the valuations placed on the samples sent to Europe by him. In 1873 brokers in Switzerland reported that the samples resembled "some imported from Mauritius some years ago. They had evidently been hurried in curing, causing all the beans to

split, which is objectionable, because the small seeds escape without the moisture being sufficiently got rid of. In the present scarcity, sample would realize forty shillings per pound." Samples of the crop of 1872 sent to London by Colonel Puckle in 1874 were valued at only ten shillings per pound, good Mauritius pods being then worth eighty shillings. Nevertheless, the brokers pronounced the pods a good product, though very faultily dried and prepared. Their official report was as follows: "Very dry, brown, foxy, and red beans, mixed, loose, of poor flavour, and mixed in length."

A sample of the same crop sent to London by the Government of India through the Chamber of Commerce at Calcutta was valued by Messrs. Lewis and Peat at about twenty-five to thirty shillings per pound. The brokers reported that having been packed in paper without tinfoil, it had become very dry. "If the bulk was packed in soldered tins, it would probably arrive in a much better condition, and be worth probably thirty-five to forty shillings per pound. Splitting the beans should be avoided. The longer and fresher the bean, the greater the value." Of the crop of 1873 some portion was reported by the Swiss brokers to be worth sixty shillings per pound.

In a report on the progress of the experiment brought down to the end of June 1875, the local authorities state that at the beginning of the year the plants in the Bangalore garden shewed a tendency to decay, the result, probably, of excessive moisture during the protracted and heavy rains of last year, as well as of the excessive use of the knife in making cuttings to meet the wants of the public. After the crop of pods was harvested towards the end of March, the plants were pruned by the removal of all dead and sickly shoots, and the healthy branches were so regulated as to admit of a free current of air. Cocoanut fibre was also applied to the roots as a manure. In the course of a month marked improvement took place; the plants shot out vigourously, and they now bear a fair crop of full-sized pods. A small sample of 5lbs. of the finest pods of the last crop, which was sent to London recently, was sold at auction for 22*s.* 4*d.* per pound. The brokers, Lewis and Peat, said that had the pods been fresh (*i. e.*, not so dry),

and tied up in small bundles of a quarter to half a pound, assorted according to length, the long pods would probably have sold for 60*s.* per pound.

It cannot be too often said that the commercial value of vanilla depends in large measure upon the manner in which the pods are packed for the market, and too much attention cannot be given to this point.

The Government of India last year instructed the Government of Bengal to resume the experimental cultivation of vanilla in a systematic and thorough manner in the Botanical Gardens, and these instructions were carried out, a construction having been erected in the gardens for the purpose. The experiment is as yet in its infancy, but the plants are thriving. Dr. King, it must be said, is not of opinion that the experiment will be a success financially, and his opinion on such matters certainly merits attentive consideration; but he does not speak from actual experience, nor does he assign any specific reason for his conclusion. There does not, indeed, seem to be any substantial ground for it. Imperfectly cured and packed as it was, the vanilla grown at Bangalore was valued at twenty-two shillings per pound in London, and this price would have nearly trebled if it had been better prepared. Now the cultivation of tobacco (the best of which sells in the Calcutta market at less than three pence per pound,) being very profitable, what reason is there to anticipate loss with vanilla, which occupies very much less space, and the preparation of which is not more troublesome or costly than the preparation of tobacco? If the cultivation of the pân (*piper betel*) is extremely profitable, then the cultivation of vanilla, which should be conducted in Bengal under exactly similar conditions, must be largely more so.

The cultivation might also be attempted with fair prospects of success elsewhere in India, and amongst other places a most favourable locality would seem to be the Andaman Islands. Here the cultivation might be undertaken under the best conditions, and large profit to the Settlement would probably ensue. An experiment has been commenced by the Superintendent of the Settlement at the suggestion of the Government of India, in the Department of Revenue, Agriculture and Commerce, and cuttings have been sent

down to Port Blair from the Botanical Gardens at Calcutta. Probably also in parts of Assam, Burma, and Lower Bengal, and other warm, humid climates, vanilla would have an excellent chance of success.

I may note here that the cultivation has been commenced in Ceylon under the care of Mr. Thwaites, Director of the Royal Botanical Gardens at Pérádeniya, and that he strongly recommends the extended cultivation of the plant because of the high price of the pod which is likely to be sustained, the moderate extent of ground required, and because, when planted on a right system, the plant requires no extraordinary care or attention. These reasons I find in a report submitted by Mr. Thwaites to the Colonial Government, dated the 28th March 1874.

For the guidance of intending cultivators I append some directions for the growth of the plant and preparation of the pods. First, I translate some paragraphs from the *Dictionnaire du Commerce et de la Navigation:* "The vanilla plant delights in the margins of small streams in humid and shady places. The pods as received in Europe are made up in packets containing fifty each, and should be fresh, unctuous, and very aromatic. The gathering commences towards the end of September. The pods are plucked and plunged for a moment in a vessel of boiling water to blanch them. They are then hung up in an airy place, and at this stage there exudes from them a viscous liquid which must be removed. The removal is facilitated by light pressure repeated two or three times a day. This desiccation is a difficult operation, and must proceed slowly. The pods are frequently oiled with mahogany-oil to keep them supple and preserve them from insects; they are also tied up with cotton thread to keep them from opening. These are delicate operations, and the rareness of complete success explains the high price of vanilla of the first quality. As soon as the pods are ready, no time is lost in wrapping them in oiled paper and packing them in tin boxes; exposed to air they would speedily lose their aroma. . . . Vanilla is often covered with a brilliant silvery efflorescence, caused by the essential salt contained by the fruit working its way out. This is called *vanille givrée*, and it is preferred to all others. This efflorescence sometimes makes its

appearance on a pod two or three years after its preparation for market; kept in a hermetically closed box it will retain its perfume for many years. Vanilla is despatched in tin boxes weighing generally from 17 to 18 kilogrammes (from about 37 to 39lbs). The buyer should assure himself that the packets in the box are entire, and that the pods are of the same length. Frauds are often practised in the retail sale of vanilla. Some unscrupulous persons impart a perfume by means of oil of benzoin to old, dried-up pods, soak them in a mixture of oil of sweet almonds and balm of Peru to restore their softness, and dust them with salt to give them the desired crystalline efflorescence."

Rhind's *Vegetable Kingdom* gives the following information: "These [the flowers] are succeeded by long and slender pods, which at first are green, but become yellow as they ripen, and are then collected for use. The cavity of the pod contains, besides its numerous seeds, a substance which is black, oily, and balsamic. When recently gathered this is humid, and its odour is said to induce a kind of temporary intoxication. The pods are harvested during the three later months of the year, and are carefully dried by exposure to the sun's rays until they are made warm, in which state they are wrapped in woollen cloth to promote and absorb evaporation. By this process the vanilla acquires a black hue with a somewhat silvery appearance. Five of the pods thus treated will usually weigh one ounce. The vanilla is easily propagated by cuttings which will yield pods in their third year, and each will continue to furnish about fifty annually for thirty or forty years."

McCulloch's *Dictionary of Commerce* says: "The Indians propagate it by planting cuttings at the foot of trees selected for that purpose. It rises to the height of eighteen or twenty feet; the flowers are of a greenish-yellow colour mixed with white; the fruit is about eight or ten inches long, of a yellow colour when gathered, but dark-brown or black when imported into Europe. It is wrinkled on the outside, and full of a vast number of seed, like grains of sand. It is collected by the Indians, who sell it to the whites, who prepare it for market. They spread it to dry in the sun for some hours, then wrap it in woollen cloths to sweat. Like pepper, it changes its colour in this operation,

becoming almost black. It is finally dried by exposing it to the sun for a day."

The following extract is from an article on the subject in *The Gardener's Chronicle*:—

"The growth is, indeed, extremely easy, as the ground requires no tilling: slips of the vanilla plant are set at the foot of a tree on the approach of the rainy season, and soon begin to spread up the trunk. The plantations are cleared once a year from weeds and undergrowth, and in the third year the plants bear fruit.

"Five varieties are recognised by the growers. One, the Vanille de Cochon, is so called from emitting an offensive smell whilst drying. The harvest begins about December, when the fruit becomes yellowish-green. There are two ways of preparing it for the market. In one method the fruit is allowed to dry until the pod loses its green colour. Straw mats covered with woollen blankets are spread on the ground, and when these are warmed through, the fruits are spread on them and exposed to the sun. After a time they are wrapped in blankets and placed in boxes covered with cloths, after which they are again exposed. In about twelve hours the fruits should become of a coffee colour, but if they do not, the process is repeated. After about two months' daily exposure they are tied up in bundles of fifty and packed in tin boxes.

"The following is another method of preparing vanilla for the market. About 12,000 of the pods are strung together by their lower end as near as possible to the foot stalk; the whole are plunged for an instant into boiling water to blanch them; they are then hung up in the open air, and exposed to the sun for a few hours. By some they are wrapped in woollen cloths to sweat. Next day they are lightly smeared with oil by means of a feather or the fingers, and are surrounded with oiled cotton to prevent the valves from opening. As they become dry, on inverting their upper end they discharge a viscid liquor from it, and they are pressed several times with oiled fingers to promote its flow. The dried pods, like the berries of pepper, change colour under the drying operation, grow brown, wrinkled, soft, and shrink to one-fourth of their original size. In this state they are touched a second time with oil, but very

sparingly, because with too much oil they would lose some of their delicious perfume.

"The chief use of the vanilla is in flavouring perfumery and confectionery, and especially chocolate. One pod is sufficient to flavour 1½lb of chocolate, being ground with sugar for that purpose. The fragrance is said to act upon the system as an aromatic stimulant, exhilarating the mind and increasing the energy of the animal system. It is occasionally employed on the Continent in cases of hysteria, and is used by the Spanish physicians in America as an antidote to poison and to the bite of venomous animals, as well as in other cases. A liquid used in Peru, where it is known as *Baume de Vanille*, exudes from the open pods at perfect maturity. The fruits in time become covered with an efflorescence of the needle-like crystals, which possess properties similar to those of benzoic acid; when viewed through a miscroscope with polarised light they are very beautiful objects."

Mr. McMurray, the gardener of the Agricultural and Horticultural Society, thus described in the Society's Journal for 1857, Vol. IX, Part III, the proper treatment of the plant in Bengal, according to his experience: "The situation should be well shaded from the sun, and the material in which the plant thrives best is a mixture of lime rubbish and brickbats, or other such material, with one-fourth half-decayed leaf mould. The whole should be well mixed together before placing it round the trunk of the tree or other situation chosen. The bed should be made three feet wide on the surface of the ground at the north-east side of the butt of the tree, and it should be raised two feet high. A quantity of the largest lumps of the material should be placed at the bottom to ensure good drainage, and the plants should be watered immediately after planting, to settle their roots in the new situation. The stems of the plants should also be fastened up to the tree, so as to encourage the roots to take hold and cling to the substance against which the plant is to grow. After this it will merely require a good drenching with water once a week only during the hot weather to ensure a healthy growth."

Dr. Balfour's *Cyclopædia* furnishes the following information :—

"To make it of commercial value, the pods should be long and of a very dark brown colour, almost approaching to black; they should also be moist, and if properly ripened before being packed, they become after a time covered with an acicular crystal, which adds to their appearance and marketable value. The blossoming commences in February and the pod ripens in December. The only enemy to dread is the cold wind in that month, which sometimes nips the pod and causes it to fall before it is properly ripened; a mild December is consequently beneficial to the vanilla fruit. The pods should be carefully dried by exposing them on cloth to the sun's rays, and while warm they should be wrapped in woollen, which promotes evaporation and at the same time absorbs the moisture. When thus treated, the pods blacken and put on a silvery lustre. On this appearing, they must again be exposed to the sun and thoroughly dried. A fully developed and properly ripened pod should be from six to seven inches long, and about three-eighths of an inch in diameter. In its native country the plant continues to bear from thirty to forty years, and yields in ordinary seasons from forty to fifty pods annually, or say half a pound weight, so that each plant may be considered equal in value to Rs. 20 per annum, requiring very little care and expense in its culture, and only an ordinary amount of care in preparing its produce for cultivation."

The useful account of the cultivation of the vanilla plant and the preparation of its pods contained in the following paper by M. David de Floris, of Réunion, I have extracted from the Journal of the Agricultural and Horticultural Society of India, Vol. XI, Part IV, 1861 :—

Vanilla Culture.—Vanilla flourishes in hot and moist regions. There are two kinds in the island of Bourbon, easily distinguishable,—the little vanilla generally spread abroad, originally from Mexico, of the best quality; and the big vanilla, with large, broad and thick leaves, inferior quality, and of which the pods fall before having attained maturity.

The vanilla is planted in cuttings at the foot of the trees which are to serve it for a protection, or along sheltered walls and palisades.

The cutting must have at least three knots; it may also have four or five knots, or even more, according to the disposition of the protecting trees or the shade which they can give.

A plantation of 2,004 cuttings which I made last year in the month of May, with creepers of from 10 to 12 feet long, gave fruit in the same year and is now in full bearing. But I must confess that these creepers had already their buds which immediately continued to shoot.

All trees are good as protectors with the exception of those which change their bark; the best are the mangoe-tree, the black-wood (*Acacia Lebbeck*), the dragon-tree (either *Dracæna Draco*, or *Pterocarpus Draco;* probably the latter), the jack-tree, the ouatier (*Bombax Malabaricum*), the pignon d'Inde (*Jatropha curcas*), &c. But among these the pignon d'Inde cannot be planted alone, on account of its shedding leaves when the vanilla trees are in bearing; the sun then striking upon the vanillas and upon their pods, is very injurious both to the one and to the other. It is necessary, therefore, to plant the pignon d'Inde between the dragon-trees and the ouatier or other trees the leaves of which may serve to shade it as well as the vanilla plant, to which it only serves for a protection during a certain period of the year.

The protecting trees ought to be planted at 5 feet by 4 from east to west, or at 6 feet by 5, according to the greater or less land possessed. They may even be planted at 6 feet by 6, which would give more air to the plantation.

The system of 5 by 4, which I have adopted in my new plantations of dragon-trees, is the one to which I give the preference; it then becomes essential to make the creepers climb from tree to tree, still from east to west, to avoid their too great agglomeration on the same prop, and to plant a strong stake between the trees so as to well steady the creepers, and to avoid the shocks which the wind or fall of branches on the interlaced creepers might cause; this fall of branches can be avoided if care is taken to prune the trees frequently.

For the vanilla plantations already formed, and where the crops are at greater distances, one must take down the creepers when they have attained too great a height, and roll them up or train them within reach on the natural branches; or else by putting strong arms to the trees which have not got them, so as to keep the creepers always within reach to facilitate their fecundation. It happens, however, that some branches are too high, which necessitates the use of ladders.

The months recognized as the best for planting are March,

In Bourbon, March, April, and May are the rainy season.

April, and May. One may, however, do so in the months of September, October, November, and December, being careful to water the plants if it is very dry at that period.

The supporting trees should give enough shade before receiving the vanilla plants. In case, however, one should require to plant before the necessary shade exists, the plants must be surrounded with palm leaves in preference, and watered much more often than if they had their natural shade; the vanilla plants should be put in the ground at the side of the supporting tree, opposed to the sun, so as to escape the heat of the sun.

The longer the cutting, the more knots must be put into the ground. One knot when the cutting has three, two when it hsa four, and four or five knots when you plant long creepers.

These cuttings should be planted laid in the ground, the tendrils towards the tree, well fixed with one, two, or several flat ties, according to their length.

They must not be tied with round string, which would finish by strangling the plants. The leaf of the vacoa (*Pandanus vacoa*) is the best tie.

If the soil is dry or poor, it is well, and even indispensable, to use mould for making the plantation; manure would be hurtful.

Young plants with roots, on the other hand, may be planted in dung, provided always that it is well rotted.

Vegetable manure, less heating, composed of leaves of blackwood or of any other strong rich leaves, is also very good, and even preferable; but it must also be well rotted, the roots of the vanilla plant, and particularly the new ones, being very tender and delicate.

Watering in the first days after planting is always an absolute necessity, particularly in a dry locality.

Plants put in the ground in the middle of winter languish, lose their buds, and often perish.

The earth is trodden down on each plant after having been watered, to avoid the action of the air, always very injurious.

If the vanilla plantation is made near the sea-shore, it is necessary to shelter it from the salt air, which would burn the plant and would render it poor and sickly.

The pruning of the protecting trees is so done as to preserve a half shade (*demi jour*), so as to have as much sun as shade, and even a little more sun.

Pods which have been too much shaded are long, soft, thin, and difficult to ripen; whereas, on the contrary, when they are sufficiently exposed to the sun, they are fat, round, firm, and contain much more flavour.

On sloping ground a west slope is preferable, so that the vanilla plant may not be exposed to the wind, and that it may receive more warmth.

It is indispensable that each of the trees which serve for a prop should be surrounded with rocks to keep in the manure, which is then covered with smaller flat rocks to avoid the evaporation of the manure, to keep the roots cool, prevent the rains washing the earth from the roots, and animals from digging up the ground.

The manure placed under the rocks is renewed once a year, a little before the flowering season.

The cuttings may be put out in a nursery, in a dry and rather shady spot, at the distance of 5 or 6 inches from each other, and alongside of supporting props on which the new shoot climbs actively.

Fecundation of the flowers.—In the flower of the vanilla the male organ is separated from the female organ by a light skin which prevents the natural fecundation. It is necessary, therefore, after the flower is completely opened, to remove this skin with a little instrument, and by a light pressure of the thumb and of the fore-finger to cause communication between the two organs.

Fecundation is made from 8 or 9 o'clock in the morning till 3 o'clock in the afternoon, and may even be carried on till 4 or 5; but pods fecundated late never acquire the length and the size of those fecundated at the proper moment.

The instrument used for this operation is generally 3 or 4 inches long, and made thin and round at one of the ends.

It must not be either sharp or triangular, in which case it would wound the organs of the flower or cause the pollen (a coloured powder in the anther) to fall, or might cut the male organ. *Les Cotons* (spathe or protecting leaves surrounding the flower?) or *nics* (according to the term we use) of the palm-tree, the plane-tree, or the cocoa-tree, are the best instruments for the fecundation. After having been used, they are, for the purpose of finding them again each morning, stuck into the leaves of the vanilla.

Light ladders are used to climb up and fecundate the flowers which are out of reach.

The organs of the flower must never be pressed with force, and this operation should always be done with much care by skilled fingers.

The flowers of the vanilla begin to appear from June and are fecundated up to September (in India from February to April).

In high and colder regions the flowers appear and the pods ripen more slowly.

The first flowers should be fecundated in preference, and the

others removed after the five or six pods, which it is desired to keep, are ascertained to have well taken.

Five or six pods on each bunch are generally left when the vanilla plant is well covered with flowers, if one wishes to obtain fine fruit. But it sometimes happens that a fine creeper only bears a few bunches; in this case one may fecundate eight or ten flowers, or even twelve in each bunch, the tree then necessarily being able to nourish more fruit. [This means that only a small proportion of the whole number of flowers should be fertilised. If all the flowers borne by the plant are fertilised, the plant will become exhausted and soon perish.—O'C.]

Harvest.—The vanilla is gathered when the pods have attained to ripeness. One knows that the pod is ripe when the end begins to turn yellow, and also by a yellowish tint—a true sign which shows the time for gathering the pods.

The pods gathered too green dry with difficulty, are liable to be mouldy, and sometimes become rotten when the weather is very damp; there are some even, the most green, which become white and are then fit for nothing.

It is necessary, therefore, to superintend the gathering, and to have it done by intelligent persons.

The gathering takes place every two or three days to prevent the pods which are too ripe from splitting. It happens sometimes, however, in spite of this precaution, that some split pods are occasionally found, either from having been forgotten, or from being hid under the leaves; these pods, which would remain unperceived, betray themselves by the delicate odour which they exhale.

The split pods are generally the finest and the best, but to solder them (reunite the two valves) it is necessary to perform a minute operation: the split part is steeped in hot water and surrounded with little bands of cloth drawn rather tight.

Thus prepared, these pods are hung in the air by means of the little bands which are used to tie them up, and thus become perfectly dry.

One can also, after the split part is soldered, pass the upper part, which seldom splits, through the hot water to hasten the drying.

The little bands are tightened two or three times, according as the pods diminish in thickness and drying.

Although superior in perfume, from the fact that they have attained their last degree of ripeness, these soldered pods, which have become round by the pressure of the little bands of cloth, are not much appreciated by the trade, which is but seldom in the habit of seeing such.

The little bands of cloth are dried out flat and serve for several years.

To gather the pod entire, it should be held by the butt end, and it is detached from the bunch by a peculiar twist, given with gentle force.

Some persons take the pod by the middle or by the end and draw it towards them, but when so treated the vanilla often breaks, and the entire bunch is detached from the tree with pods still green.

Other persons also gather the vanilla by pinching it off with the nails, but then the butt end no longer existing, prevents uniformity in the packets and raises difficulties for the sale.

At the end of the harvest, the last pods ripening together, the entire bunch should be gathered.

Preparation of the pods.—At each gathering, after the pods have been detached from the bunches and put in a basket, this basket is plunged from 18 to 20 seconds in a vessel of hot *but not boiling* water. The little beans should be scalded separately, but only for 15 seconds. To ascertain if the water has reached the proper degree of heat, one should be able to bear one's finger in it, feeling the heat strongly, or to seize the moment when the water throws off a thick steam and begins to make the singing noise which denotes the approach of boiling point.

Then, taking the pods from the basket, they should immediately be spread on dry grass, on mats, or on gunny, to be drained.

About a quarter of an hour after this operation they are exposed to the sun for from six to eight days, or sometimes longer, according to the weather, on tables previously covered with woollen coverings, until the pods become brown and withered.

Every evening they are gathered into chests also lined with woollen cloth, in which they are allowed to steam.

When they have become withered and brown after the proper exposure to the sun, they are put in the shade, in an airy locality, on little tables again covered with woollen cloth, so as to hasten their drying, to prevent their getting mouldy—above all to induce them to preserve, although dry, the pliability required by the trade.

These pods remain upon little tables until they are dry.

While they are still exposed to the sun, at 2 or 3 o'clock in the afternoon, while they are still hot, it is necessary to press the pods with some degree of force between the fingers to flatten them a little and to spread equally and regularly through the pod the essential oil and the seed, which are in greater abundance in the lower end, to render it supple and lustrous, and, in short,

more fit for the trade, which requires it to be thus prepared. This operation is performed some days after their exposure to the sun, when they have become sufficiently faded, but always before they are put to dry.

One ascertains easily that the pods are dry when they have become black, or rather of a chocolate colour, and when there does not remain any moisture, particularly on the butt end, the part which always dries last.

The dry pods are chosen and put into boxes of tin, where they attain their last degree of perfect dryness and pliability.

This is done every two or three days, and sometimes becomes necessary every day, according to the number of men employed, and especially at the end of the harvest.

The pods are then put up in packets, and for the pods in each packet to be of the same length it is necessary to work with a large quantity of dry pods.

The packets are composed of 50 pods tied round the middle, and also by preference a little lower towards the end of the pods, which, without this precaution, might open at the ends.

For tying the packets it is best to use the string of the *rabane*, a dry, supple, and strong string.

Packing.—The packing is done in tin boxes made according to the length of the pods and length of the packets to be enclosed. Each box contains sixty packets, or six rows of tin packets one above the other.

This package, similar to that of Mexico, is required by the trade.

The tin boxes are covered with a label showing the number of packets, the length of the pods, their net weight, and the tare of the boxes.

They are then (if it is intended to send them to France) enclosed in a wooden case just of a size to hold them, and to preserve these tin boxes from rust it is advisable, and even necessary, to surround them with sawdust.

Frost.—The frost (white and shining crystals or benzoic acid) forms upon the pods when they are shut into well-closed vessels after they have been packed up for three or four months.

Several traders require frosted vanilla in preference; others do not seem to care about it; others again require, when the vanilla has just arrived in France, the means of frosting it before exposing it for sale.

It does not belong to us, I think, to judge this question, of itself sufficiently delicate, nor to prevent the frost from forming naturally upon the pods, and still less to use any means which would necessarily injure the beauty or the perfume of the pods.

For a person making a sufficiently large quantity of vanilla it is necessary, to enable him to expose it to the sun, for him to have large tables or stakes driven into the ground on which it is easy to erect a light trellis of lathes, so as to be able, in case of rain, to cover them with waxed or oiled cloth.

Vanilla after having been dried loses about one-fifth of its original weight.

A vanilla garden which produces 500 kilogrammes (above 1,000lbs.) can be carried on, according to my calculation, by ten workmen, who, when well experienced, will suffice for the fecundation of the flowers. These workmen might be often employed on other work in the course of the year.

The vanilla plants are renewed every eight or ten years. This, however, depends on the size of the cuttings planted, and also on the localities where they have been grown.

There are a quantity of other details which may be observed, but I think I need not indicate them, as these notes contain what is essential to be known for obtaining good results.

Supplementary Notes on the Pamphlet of M. D. DE FLORIS, *intended as a modification of the Vanilla Culture in India. By Captain* W. H. LOWTHER.

I. The first mentioned—known to botanists as *Vanilla aromatica*—yields the best description of produce, and bears *more* abundantly than the more showy large-leaved *V. planifolia*, of which plant I saw very few specimens in the *Vanilleries;* but about the town it is very common, and seems to be preferred as a more ornamental, if not useful, auxiliary to a frontage.

II. The finest vanilla creepers I have seen in Bourbon grow in the beautiful little gardens and enclosures surrounding the villas and cottages of the capital, and cultivated in every possible form. Sometimes festooning the tall, straight stem of a palm; sometimes spreading wildly over an arbour; now creeping vigorously over some damp, dark wall, and insinuating new germs in every hole and crevice; now composing an evergreen hedge, interwoven with laths, day by day on the symmetrical espalier; frequently found a neglected and dishevelled heap of runners and pods, and occasionally an intrusive parasite, overwhelming roses and lilies in an unchecked career: in truth, almost every house-proprietor of St. Denis is a more or less grower of the costly aromatic.

III. In the delightful temperate climate of Bourbon, where shade and moisture, temperature and soil, are all beautifully balanced, very little preparation is requisite for the rapid formation

of roots or cuttings; but in the most favourable parts of India it will be found indispensable to form healthy plants in a nursery previously to attempting a plantation.

IV. The system of putting out adult plants would hardly succeed in India; they would probably receive so severe a check as to kill them down to their roots, which frequently occurs in Bourbon when suddenly transplanted to exposed localities in dry weather. Too much hand-watering can hardly be bestowed, on the leaves and runners especially; and the intermediate watercourses should be kept flowing in dry weather all the twenty-four hours.

V. The proper kinds of trees as protectors or shade-givers is an experimental question for the Indian cultivator; he will find a larger variety to choose from than in Bourbon, and there are many among them which are easily produced in a few months by driving well-budded stakes into the ground, as the *peepul* (*Ficus religiosa*), *Bauhinia*, *Ficus*, *Erythrina*, &c., &c. The jack and mangoe, too (as in Bourbon), would yield a considerable profit from their fruit; they furnish more shade than most other trees.

I think I should prefer to form a plantation in some virgin forest having a considerable stream of water throughout its length, and where I could make immediate use of the old shady trees, to say nothing of a suitable soil and moist climate. In Central and Lower Assam all these indispensable features of locality are abundant.

In Calcutta and its vicinity the extremes of temperature are far too great for a vanilla-grower.*

VI. The distance between the shade-givers for India must be greatly diminished, and it will be desirable that a portion of the trees cast their foliage: for this purpose none is better than the *Erythrina* (called in Assam *meddar*), and which is already so much employed in India in the plantations of pân, pepper and coffee, shedding its leaves when the sun loses his force, and recovering them when he begins to burn.

VII. The seasons in Bourbon are exactly opposite to those of India; hence June, July and August are cold months, and planting out is suspended during the above period. For India, as elsewhere, the proper time to transplant every green thing is when it gives sign of recommencing growth after the term of rest: thus February (or the end of January in some seasons) will be found the best time to begin a plantation. It is hardly possible to give too much shade during three-fourths of the year, and the same with regard to irrigation. In the *vanillerie* of Mons. Gausson, the produce of which in the past season sold for 70,000

* *N. B.*—This is quite a mistake.—O'C.

or 80,000 rupees, the natural forest has been used for shelter, and even the massive rocks. The hill sides have been terraced at considerable expense and labour, serpentine paths being carried along conveniently through the heart of the estate, with a beautiful little river falling in cascades and meandering through this artificial wilderness, and yielding an inexhaustible supply of the great necessity—water. There are altogether sixty labourers of sorts and sizes, divided into classes, each restricted to some particular operation in the culture and curing, and paid according to their qualifications. There is not an *espalier* in the whole estate, but the creepers are encouraged to climb in the most natural manner from rock to rock and from trunk to trunk, the only access to these difficult supports being by bamboo ladders. In no other plantation is the plant so healthy or so productive, fifty to sixty pods in a single creeper being very common. The labourers are chiefly Madras coolies, the negroes being found too lazy and stupid as gardeners. These plantations are situated between two lofty mountains, so that only one-half is touched by the sun during the twenty-four hours. For India I should add root shade to promote moisture, and ferns or mosses might be found useful for this purpose; heaps of leaves, dried weeds, or straw are used here to protect new *vanilleries* with the same object. Watercourses, after the "Koormie" fashion of India, are very much employed in new plantations, with occasional tanks and reservoirs for filling the watering-pots. Those in use by Mons. Gausson are of copper, made to order in France, and holding several gallons, the rose being made very fine, and thus giving a well-spread rain-like shower to the foliage.

VIII. Hardly applicable to an Indian *vanillerie*, where I should prefer (as before stated) plants well rooted in a nursery to any cuttings whatever.

IX. The fibres of plantains, or *Pandanus vacoa*, are soft and strong as binders, and usually fall off by decay when the vanilla has attached itself to the trees.

X. A gritty, friable, but at the same time very rich soil is the one I should select, and it would not be very expensive to produce these properties artificially. I would prepare small pits previous to forming a plantation—say three feet deep by two feet wide; these to be filled with a compost of two-thirds vegetable mould, and the other one-third a mixture of coarse sand and pounded stone or gravel (of all sizes from a mustard seed to a pea): these pits to be watered daily, and all hollows and holes filled up, the surface of the pit soil being raised in the centre to about three inches above the ground level; the plant being very liable to rot if the drainage be imperfect.

In each of these pits I would place two healthy well-rooted plants of a foot high (or in favourable localities two feet), watering them freely by hand before sunrise and after sunset, and letting the intermediate watercourses run at least once a day when no rain falls. When firmly established, I should give a slight surface manuring of decayed leaves and half-rotted stable dung; but this operation requires much attention and superintendence. On M. Gausson's estate the manure of several horses, mules, and cows, rotted with leaves and jungle, is used once a year to stimulate the plants, the most vigorous season of growth, *viz.*, the first appearance of blossom, being selected. Liquid manure would probably answer much better, but I did not find it in use.

XI. In India, where hot and pernicious winds are so prevalent, I should (if not able to obtain a mountainous locality with a temperate climate) choose a site with heavy forests immediately situated on the north and east, and having bamboos and plantain gardens on the south and west. Air and sun, however, will be required in moderation, and the plant will in this respect require continual watching. As I before observed, a long narrow valley between wooded mountains, watered by an inexhaustible stream, the soil ferruginous, and a climate where the thermometer rarely changes above or below 70 or 80 degrees, are the natural advantages to be sought for by the vanilla-grower.

XII. It is a well-established fact that without artificial impregnation of the blossoms, not one in one hundred will set its fruit, and equally so that not five per cent. fail in doing so when the operation is properly performed; while in its native forests of Brazil, not only is the fecundation beautifully executed by one of Dame Nature's small servants—a kind of bee—but the vanilla pods are of a quality which the Bourbon cultivators have in vain tried to equal, and grow in all their primitive wildness! Strange to say, Nature has failed this season in South America, and the Bourbon planters are now reaping the golden reward of their labours. In India very great attention must be paid to the proper hours of fecundation, or extensive failure would be the result. Experiments on a small scale will soon establish the most suitable period for manipulation. For the rude hands of Hindoo gardeners, I would recommend a lance-like instrument of bone or horn, and rather less blunt than a finger-nail. Bamboo ladders, too, will be required where the tree system is followed, and which, to my observation, seems the proper one for India: true, it entails more labour and expense, but this is amply repaid in the quantity and quality of the produce, to say nothing of protection from thieves and trespassers.

XIII. Pruning is as essential an operation in this branch

of gardening as it is in the akin employments of the orchard or parterre: one bundle of exquisitely perfumed and well-sized pods is worth many, many times more in the commercial world than a dozen of inferior produce; and it is to these two main points that the vanilla-grower must direct all his endeavours and abilities. The fame of this costly aromatic may be lost or gained in proportion to the exertions and precautions of the grower, more particularly during the final process of preparation. The number of pods permitted to attain maturity on a single creeper will, of course, depend very much on the climate and corresponding vigour of the plant.

The delicate operations of pruning, fecundation, and gathering, are always specially entrusted to some well-tried and well-paid individuals of the establishment, for extensive damage and loss would assuredly attend even trifling neglect.

For India I think the "modern fruit-gatherer" (on a much smaller scale) would be the proper *modus operandi* in collecting the pods, which are irretrievably injured by a rude grasp or clammy hands. This tool consists of a very sharp scissor like a pair of blades, attached to a little wire purse or basket, and moved by a spring handle. The pods when cut off would be occasionally emptied into a pannier with a lid, and this should be taken away to the curing-house when full, so as to avoid loss of aroma by exposure.

In India, where everything in vegetation ripens and rots at very short notice, depending on the sudden and various changes of weather, very strict surveillance of the ripening will be necessary, and it is equally certain that the sun must not be trusted to the same extent as in Bourbon. Under a sky where everything essential and aromatic evaporates by exposure, it will be necessary to employ other modes of curing than by solar heat, otherwise there will be loss of aroma and deterioration of shape (perhaps also of crystallization)—the most serious obstacles to ready sale. In glass cases carefully adjusted to a sand-bath in a shaded room, and guarded by a thermometer, it seems to me that the crystallizing process might be conducted in the greatest perfection, and the external appearance of the pods rendered even superior to the Bourbon samples. What if benzoic acid were delicately sublimated under the said glass covers, and thus thrown on the fruit in an acicular form?

[In a subsequent communication Captain Lowther forwarded the following additional notes.]

1. Healthy plants in vigorous state of growth attain one inch per diem; a very simple index denoted eight inches in the week. This was during warm, showery weather.

2. The roots of the vanilla plant require frequent attention. It will be as well to surround them with some effective guard against heavy floods of rain or injury from accidents, for on them not only depends the health but the very life of the creeper, which is not exactly a parasite or orchid as most people suppose. These are the first symptoms of radical disturbance. The cultivators bend downwards the main stem and peg it down as a layer, which soon strikes and restores the health of the plant.

3. A well-managed plantation of one acre, being the enclosure of a small villa in St. Denis, yielded to the family inhabiting it 15,000 *francs* last season (Rs. 6,000). Nothing can be more simple or inexpensive than this branch of cultivation, which is much followed as a profitable amusement by the ladies here.

4. Too much shade, or shade badly applied, seems almost as prejudicial to a good crop as the other extreme of exposure.

5. No plant should be allowed to bear too freely; the quality and size of the pods suffer thereby. The pruning should be proportioned to the age and health of the creeper; no more than five or six pods are allowed to a single cluster. A plant of three or four years' growth has hundreds of blossoms thereon, but no more than half a pound of dried produce should be taken from the same. The pruning should be performed after the pods are fairly set, as in fruit gardening.

The completest account I have yet seen of the processes of fertilisation of the flower and manufacture of the pod is contained in a pamphlet entitled *Etude sur la Vanille*, by Dr. A. Delteil, of Réunion, published at Paris in 1874. The subjoined paragraphs are a condensed translation which I have made of the substance of Dr. Delteil's book, to which also I am indebted for the illustration at the beginning of this pamphlet.

Impregnation.

In consequence of the peculiar disposition of the male and female organs, which are separated by a broad membrane, vanilla is difficult of fertilisation unless aided by the hand of man or the operations of winged insects flitting in search of subsistence from flower to flower, or perhaps the action of the wind. Left to itself it would remain almost wholly sterile, and the action of insects and of winds is so uncertain that it becomes necessary for man to interfere.

The flowers are produced in clusters in the axils of the leaves. A plant in full health and strength may produce as

many as two hundred clusters at a time, each cluster consisting of from fifteen to twenty flowers. A single plant, therefore, may bear three or four thousand flowers. The flowers in a cluster expand one after the other and only last a day. It is desirable not to fertilise more than two or three flowers in each cluster, and to select for the operation the largest and finest flowers. These are generally to be found amongst the flowers which are the first to open. If this rule be observed, it will be found that the quality of the pods will largely compensate for the quantity which might be obtained by fertilising a larger number of flowers.

The best time for impregnation is from 8 o'clock in the morning to 1 or 2 o'clock in the afternoon, and as far as possible the day after rain. The operation is not likely to be very successful either during rain or during prolonged dry weather.

M. Delteil strongly recommends, with a view to nurse the plants and prevent them from being exhausted by too frequent production, that the plantation should be divided into four squares of equal size, the fertilising operation being carried out in only one of these each year.

Each plant will thus have three years' rest and remain fit for many successive fertilisations.

The neglect of precautions in this respect has been the cause of widespread disease in the vanilla plantations of Réunion.

M. Delteil remarks that in all the plantations he has inspected the disease appears under the same aspect, *viz.*, a gradual decay of the plant, commencing after the second and third fecundation. Decay generally appears first in the roots and at the base of the stem, sometimes at the summit of the plant. The aerial roots wither before touching the ground, and the whole plant becomes soft and discoloured and afterwards dries up, the fruit often rotting before it ripens. The cause of the disease is ascribed by M. Delteil to over-cultivation. The plant is fatigued by repeated and too extensive fertilisations, is grown from unhealthy cuttings in many cases, and is cultivated with the object of obtaining an immediate return much beyond its power to give. In short, the plant dies rather from exhaustion than from disease.

Instruments employed in fertilisation.

The instrument employed in fertilisation is simply either a small bamboo, about 2½ or 3 inches long, cut very thin and rounded off at one end, or the dorsal rib of the leaves of palms, cocoanuts, or *latanias* (these are Réunion palms). With a cutting tool, such as the point of a pen-knife, the danger of wounding the delicate organs of the flower is incurred. The operation is quite simple, and may be executed with great rapidity by a light and practised hand. An expert person will fertilise as many as a thousand flowers and upwards in the course of a forenoon. The mode of operation is as follows :— Seize the base of the flower between the thumb and middle finger of the left hand, placing the forefinger on the back of the gynostemium* to support it. Or, between the fore and middle finger of the left hand, held horizontally, place the three upper petals of the flower, raising your thumb and keeping it close to the anther. This position is preferable to the one first described and admits of more skilful execution of the operation. Now, with the little instrument held in your right hand, you tear the piece of the corolla resembling a hood, in order to expose the organs of fecundation. You then introduce the end of the little bamboo under the upper valve or operculum of the female organ, and raise it straight up so as to be concealed under the male organ or stamen. When this operculum is properly and completely raised, the stamen, which at first rises with it, tends to return to its position bending towards the female organ. This inclination you must now assist with the thumb of your left hand, lightly pressing the stamen against the stigma to which it will adhere. Nothing now remains to be done but gently to withdraw the little bamboo, and the flower is fertilized. The plate very clearly illustrates the operations here described.

If at the end of the third day, the flower, which begins to wither immediately after the operation, maintains its position on the summit of the ovary, the operation has been successfull. When the requisite number of flowers has been successfully fertilised, the part of the flower stalk supporting the other buds should be broken to prevent them from expanding.

* The gynostemium is the column of orchids, *i. e.*, the part formed by the union of stamens, style, and stigma.

By the end of the first month the fruit attains the size of a ripe pod, though it is not fully developed until it is six or seven months' old. Pods which ripen in the shade are not so highly perfumed as those which have been exposed to the sun. It is, therefore, desirable to remove such branches of the supporting trees as intercept the free transmission of the sun's rays to the fruit, especially in the later months preceding the plucking.

Harvest.

The first pods are generally inferior to those produced later on. It is most important that pods should not be plucked until they arrive at the proper stage of ripeness; otherwise they ferment and rot in a few months after preparation. Certain signs exist by which the planter may satisfy himself that the pods are fit to pluck; for instance, when the larger end of the pod begins to turn yellow the fruit should be plucked at once. If left on the plant the pods will split and the produce will be inferior. It is advisable to visit the plantation frequently when the time for ripening approaches and pluck the pods from day to day as they reach the required degree of maturity. Care should be taken to gather the pods when the morrow promises to be fine, as they must be exposed for several hours to the sun the day after they have been plucked.

It may be well to add that some precaution is required in separating the pods from the stem. The fruit should be grasped with the right hand towards the butt-end and removed from the stem by a gentle twist from right to left. Some persons cut through the stalk of the fruit, but it not unfrequently happens when this is done that the butt-end is cut, and then uniformity in the packets can no longer be obtained. Again, if when you wish to pluck a fruit, you take hold of it by the middle and pull it roughly, you run the risk of breaking the butt-end, and indeed of bringing down the whole cluster of fruit, ripe and unripe, on your head.

Preparation of the Pods.

Two different systems, with immaterial modifications in each, are practised in various countries. The principle of one of these systems is to allow the pod to ripen freely by alternate exposure for some time to sun and shade. In the other

system, boiling water or a vapour bath at a temperature of 70° centigrade is employed to arrest the progress of vegetation, prevent the pod from bursting, and impart to it the shape and appearance required by the trade.

The first method can be employed only in the warm regions of South America, where the average temperature is 30°. The pods thus prepared are consumed locally and never sent to Europe. We append a brief description of the various processes employed in the countries where vanilla is indigenous :—

Guiana.—Here the process consists of exposure in the shade. The pods of Guiana vanilla are short and thick, closely resembling the little banana called *Bacove*, and from this fruit the vanilla is called Bacove vanilla. The plant grows with remarkable vigour, but has not become an object of industrial cultivation. The quantity prepared is merely sufficient for local consumption, a few kilogrammes. The pods are plucked as soon as they have thoroughly ripened and commence to split, and are then hung on strings in the shade in well ventilated rooms, care being taken to tie up each pod with thread, which is tightened from time to time to prevent the pod from bursting. The curing is complete in from 15 to 20 days, when the pods are found to be black, greasy, and filled with a balsamic and perfumed oil which exudes on the slightest pressure. The smell of these pods is stronger and more penetrating than that of Bourbon vanilla, and if well prepared they would probably meet with much favour in the European market.

Mexico.—In Mexico vanilla is cultivated in the warm and humid climates possessed by such provinces as Misantle, Popontle, Nantle, and Colipe. Planting takes place in the rains, and the harvest is gathered in December. There are five species of the plant, locally known by the following names :—

1.—*Vanilla corriente (V. aromatica)*, held in greatest esteem for the quality of the pods. Five varieties of this species are known to the trade, *viz.*—

A fleshy and long vanilla.

Vanilla chicafina, only half as long as the foregoing.

Vanilla sacata, with a finer cuticle than the first.

Vanilla resecata, small, dry, and only a fourth of the length of the preceding variety.

Vanilla basura, a very inferior product.

2.—*Vanilla sylvestra,* or *simarona,* a wild species with smaller fruit than the *corriente.*

3.—*Vanilla mestiza,* rounder fruit.

4.—*Vanilla puerca,* or swine vanilla, with a disagreeable smell.

5.—*Vanilla pompona,* thick and short fruit, agreeable smell, called *vanillon.*

The modes of preparation are tolerably numerous.

Exposure to the sun.—In some provinces the pods are placed on straw which is covered with woollen cloth and the pods are thus exposed to the heat of the sun for several days. The pods are then enclosed in boxes or chests lined with woollen cloth to make them sweat, when after a time the vanilla blackens. The preparation is then completed by further exposure to the heat of the sun. Exposure to the sun for two months is required for vanilla of good quality.

The *fire process* is as follows: During the rainy season at Colipe, according to Humboldt, the Indians make a frame-work of small reeds. This frame is suspended to cords and is covered with a woollen cloth on which the pods are placed. A slow fire is lit below the frame which is then swung to and fro, alternately approaching and receding from the centre of heat.

Another process is that of *fermentation,* adopted in some districts. The pods are plucked when they become yellow and are about to open, and are placed in small heaps to ferment, like cacao, for two or three days. They are then spread out in the sun, and when the fruit is half-dried, it is flattened by pressure with the hand and covered with castor-oil.

The process of curing with *boiling water,* which is employed in Peru and Guiana as well as in Mexico, consists in rapidly plunging the pods in boiling water to bleach them, and then hanging them up in the open air for twenty days to dry.

The most modern process is that of *Kiln-drying.* M. Delteil says that this process, which has of late

years been introduced into Réunion, furnishes very good results in practised and skilful hands. It is spreading fast, and many vanilla-planters are adopting the new system and abandoning the old processes. In Réunion it is called the Mexican process. After the pods are plucked they are carefully wiped and placed, as far as possible, in heaps containing pods of equal size. From these heaps parcels are formed containing about one thousand pods placed in horizontal layers, heads and tails alternately, so as to keep them all at the same level. Each packet should be about 54 centimètres long (say 21 inches), the other dimensions being regulated according to the length and thickness of the pods. The packet is then neatly and carefully wrapped in an old woollen covering, which is again wrapped in a covering of green plantain leaves, and the whole is then sewn up in a piece of gunny which has previously been damped and wrung out. Small supports of wood are arranged to receive each packet, immediate contact of which with the floor of the oven would be injurious. The construction of the oven must be regulated according to the work required. A kiln of 2 mètres in length and 70 centimètres high from the floor to the inner roof will dry a dozen packets, each containing a thousand pods. The interior should be well cemented to retain the heat as long as possible. After heating the oven, the coal and ashes are withdrawn and it is allowed to cool. This is the delicate point of the operation. The degree of temperature may, indeed, vary from 50° to 75° centigrade, according to the quality of the kiln, the dimensions of the pods, the number of packets to be placed in the kiln, and the time during which the vanilla is to remain in it. Practice and experience must decide in each separate case. But it is important that to ascertain and verify the temperature of the kiln, a thermometer on a wooden support should be placed in the oven and there hermetically enclosed for ten minutes. When the temperature is well regulated, the packets are introduced on their supports, care being taken to insert in the oven first the packets containing the largest pods and lastly those which contain the smallest. The packets are so arranged as not to touch each other, and the door of the oven is then shut.

The packets containing the smallest pods may be withdrawn at the end of twenty-four hours, the others after

thirty-six hours. The withdrawal should, if possible, be effected during the day so as to profit by some hours of sunshine. On withdrawal the pods should have a fine, uniform puce colour. They must be carefully wiped and then placed in the sun, between two woollen cloths, every day, from 9 A. M. to 2-30 P. M. They should be removed from the action of the sun when they are well emptied *(dégorgées) i. e.*, when no part of the pod offers any resistance under pressure from the fingers. This again is a delicate and important point. The curing terminates in the ordinary manner in a drying house, the minute precautions detailed below in the account of the method adopted in Réunion being taken.

Preparation in Runion.

The process generally employed now is that of *boiling water*, which affords excellent results when pains are taken not to neglect any of the various manipulations required, and especially when the pods are plucked perfectly ripe from a healthy plant. The necessary apparatus should first be got ready when the harvest is completed, *viz.*, large iron kettles, cylindrical baskets of rattan, mats, tables covered with black woollen cloth, and two or three other coverings of the same material. The kettles are filled with water and set on the fire. As soon as the water is ready to boil, but before it actually reaches the point of ebullition (*i. e.*, at a temperature of 85° to 90° centigrade), the rattan baskets containing the pods are plunged in the water. Sometimes the immersion lasts only 15 or 20 seconds and is not repeated. Sometimes the baskets are immersed and slowly withdrawn two or three times, remaining in the water three or four seconds each time. After each operation the baskets are emptied on tables kept ready for the purpose, or on mats, to let the water drain off from the pods. When all the pods have been scalded, they are heaped up, covered, and left to steam for a quarter of an hour. They are then spread on tables, covered with a woollen cloth, and exposed to the action of the sun until 2 or 3 o'clock in the afternoon, after which they are rolled up in the coverings in which they have been warmed in the sun, and placed in a close room where they keep warm until the next day. They may also after exposure to the sun be piled in boxes lined with woollen cloth, in which they preserve their

heat better during the night. This exposure to the sun in woollen coverings lasts for four, six or eight days according to the weather. Care must be taken to look to the pods from time to time and withdraw such as may seem likely to suffer from further exposure to the sun. The pods reach this stage when they become supple and the epidermis having attained a uniform chocolate brown colour is appreciably wrinkled by longitudinal fissures. If the exposure to the sun lasts too long, the pods become dry and reddish, are less aromatic and less appreciated by the trade.

The pods are next carried to the drying room, the windows of which face the west and are opened at midday when the sun is at its hottest. Ranged round the room is a series of shelves, one over the other at a distance of about 15 centimètres apart, to allow free circulation of air. These shelves should be made in open-work or of rattan. On these the vanilla remains for 30 or 40 days according to the degree of desiccation required. During this time they must be constantly attended to, and the more advanced pods separated from the others. If when a pod is taken between the thumb and forefinger of one hand the thumb and forefinger of the other can be passed along its whole length without meeting with any roughness or inequality, the pod is fit for the market. When they reach this condition the pods are black, supple, and wrinkled, and flatten easily. They are now ready to be packed. First they are placed in a well-closed tin box to prevent any increase of dryness which would be injurious. In this they are kept until they can be packed, care being taken to examine them every week and remove any mouldy pods.

Two months at least are required to carry this process out thoroughly. It is estimated that the prepared pods lose about one-fifth of their weight, and that five kilos of green vanilla are required to obtain one kilo of prepared pods.

Before the pods are packed, they must be shaped and sorted. They are shaped one by one, the pod being gently bent back on the side opposite the curve, each end being held between the finger and thumb of each hand. The object of this process is to give the pods a better shape and to restore them to their normal length. After this they are sorted into three classes: the first, consisting of only perfumed and

black pods, having no defect apart from that of size; the second, of over-dried pods, reddish in colour and with roughnesses on the epidermis; the third, of split pods. Each kind is placed in a separate box.

The next process is that of measuring. This is an important matter, each size of pod having its own distinctive commercial value. The method in Réunion is somewhat elaborate, but a description is unnecessary. When the measuring has been completed and the pods separated, they are tied up in packets of 50 pods each according to size, and placed in tin boxes, well closed. These are again carefully sorted, and divided into parcels of 24 each, 16 of the best kind being carefully selected to form the outer part of each parcel, 8 others of the straightest shape forming the heart of the bundle. These are all neatly tied together with a fibrous cord at each extremity of the pods, and the packet is enclosed in a hermetically-sealed tin box. Take care not to wrap the pods in paper or any other covering. The tin box should contain nothing but the bundle of pods. After the box has been soldered and duly labelled, the vanilla is ready for the market. In Réunion each tin box contains from 10 to 12 kilos of vanilla, and three tin boxes are enclosed in a wooden packing case, which thus generally weighs from 30 to 40 kilos.

It will be noticed that in the description above given of the processes employed in Réunion no mention is made of the practice common in America of rubbing the pods with oil. This practice is in fact not employed in the Island, and M. Delteil is of opinion that its omission is perhaps a mistake, and that there might be some advantage in rubbing the pods before they are made up in packets with the balsamic oil which exudes from the pods allowed to ripen naturally on the plant in the shade. To obtain this oil it would suffice to hang up a certain number of such pods, which should be gathered after having split in the drying house, and to collect the oil with the finger as it drops slowly down to the end of the pod. To obtain a tolerable quantity of the oil, a string might be tied round the pod, compressing it from time to time. Treated thus, the pods under preparation would certainly be more unctuous, more strongly perfumed and less liable to prompt desiccation than otherwise.

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NOTES ON TREE-PLANTING AND THE WATER SUPPLY OF THE DECCAN.

BOMBAY BRANCH
OF THE
Royal Asiatic Society.
CLASS

NOTES ON TREE-PLANTING, &c.

THE existing juncture of affairs in connection with the Deccan famine presents a seasonable opportunity for offering a few remarks on a subject about which a very great degree of popular error would at all times seem to prevail. The matter I allude to is the close relation which obtains between the forest vegetation of a country and the permanent water supply. So far as it affects the Deccan, the discussion of this highly important question involves also the consideration of other matters more or less intimately associated with it, such, for example, as irrigation and tree-planting. In a letter on "Rainfall and Vegetation" I had occasion some months ago to address to one of the local newpapers, (the *Bombay Gazette*,) I was necessarily obliged to treat the subject in a somewhat general manner; from that letter a few of the immediately succeeding observations are taken. The preliminary facts and arguments, now about to be brought forward in much greater detail, I purpose to make use of later on to assist in furnishing answers to the inquiries:—Whether, by largely increasing the extent of its arboreal vegetation, the annual rainfall of the Deccan cannot be augment-

ed; and, what is of far greater moment, whether it is not within our power to cause its ordinary rainfall to be so stored up in the earth as to provide a never-failing water supply for the agricultural wants of the district.

In order that there may be a clear comprehension of the grounds on which my conclusions and suggestions are to be based, I shall proceed in the first place to consider the facts which have led many careful observers to believe that forests exercise a distinct influence on the rainfall of a district, rendering it more abundant than it would have been were there no forests. It is a well established fact that all terrestrial plants possess the power of exhaling into the atmosphere, through their leaves, incredible quantities of aqueous vapour. They act by drawing up water from the soil by means of the roots, through whose agency the whole of their fluid supplies are obtained, while all their superfluous moisture is delivered into the air from the leaves. The amount of moisture which is exhaled by the leaves and young green parts of a plant has been the subject of numerous experiments. A cabbage plant, for example, with a surface of 2,736 square inches, was found to exhale nineteen ounces of fluid in a day; while a maize plant, during its short life of less than four months, was estimated by careful measurement to have given off thirty-six times its weight of water. It is not

difficult to imagine, then, what an enormous quantity of watery vapour is exhaled on a warm dry day by an extensive forest in full leaf. The amount of evaporation is influenced by many circumstances, the more important of which are the degree of light, the state of the atmosphere as regards its temperature, and the quantity of moisture it holds; while the kind of plant, the age and texture of the leaf, and the temperature and chemical composition of the soil, have also to be taken into account.

One effect of this abundant evaporation is to lower the temperature of the air which is in contact with the leaves, and another is to increase its humidity. Suppose, therefore, a large area of forest to have its temperature thus lowered beneath that of the surrounding district, we can easily understand the effect it ought, according to theory, to produce on *warmer* moisture-laden winds when they pass over it—it will act like a range of low hills situated across the direction from whence they come, and will tend to condense their vapour into rain. An account of one or two of the instances in which this effect is asserted to have been actually produced, both by artificial planting and by the encouragement of natural forests, may not be uninteresting. In Lower Egypt it is stated that since Mahomed Ali formed his great plantations of fruit and other trees, the rainfall, formerly very scanty, has increased; but the truth of this

statement has often been disputed, and by intelligent Europeans whose residence in the country began before the plantations were made. In the island of St. Helena, where the wooded surface has been extended considerably, after the former destruction of the vegetation by goats, it is said that the rainfall has increased in the same proportion. A similar statement has been made as regards Southern France, where districts that were denuded of their natural woods have once more been covered with trees artificially planted. There are also many instances recorded where the destruction of forest is supposed to have been followed by a diminution of the rainfall. The aridity of Spain is said to be mainly due to this cause. Several of the West Indian Islands, parts of the United States, Palestine, Northern Africa, and some districts of Germany are likewise asserted, with how much truth I know not, to have suffered through the same agency. A well-attested recent case, however, is that of the island of Mauritius; this has suffered from repeated droughts since the natural forest was removed to make way for sugar plantations, such droughts being formerly unknown. Theoretically, it would seem that forests *ought* to exert a considerable influence over the amount of rainfall,—that the cooling of the atmosphere in their immediate vicinity would produce a greater precipitation from the warmer

moisture-laden winds that may happen to blow over them. There can still, I think, be no reasonable doubt that forest-clad hills cause a more abundant precipitation from a rain-bringing wind than they would if they were bare. It is almost unnecessary to observe here that a range of hills in the way of a warm moist wind, like the south-west monsoon, occasions precipitation of rain through the cooling influences of increased elevation and diminished pressure. From what has just been said about vegetation, there will be no difficulty in understanding that this cooling influence will be augmented by the hills being covered with forest. In spite, however, of the numerous instances where it is alleged that the extension of forest has increased the annual rainfall and the destruction of vegetation lessened it, we are still in want of conclusive demonstration that the forest of a plain affects the amount of precipitation. The balance of testimony certainly favours the opinion that more rain falls in wooded than in open countries; but a one-sided observation like this may be met by the rejoinder, that it is to the greater rainfall the forest itself possibly owes its existence. It is highly probable the truth lies between the two extremes, and that both rain and forest re-act on each other. That forests add to the humidity of the surrounding air and at the same

time cool it cannot be disputed, while there is good reason to believe that if they do not actually augment the amount of rainfall, they at least equalize its distribution. But, let the rainfall be increased or not by vegetation, this will appear a matter of very minor importance when the other influences of forest on the water supply of a country come to be considered.

These influences are mostly mechanical. By means of their roots trees bind the soil and prevent it from being washed away, while their branches and leaves protect it against the direct shock of heavy rains; their trunks, together with the usual undergrowth of shrubs and small vegetation, oppose obstacles to the rapid flow of the rain water from the surface, and time is thus allowed it to sink into the earth. Here again the roots exercise a beneficial action—the water of the soil follows them downwards, and a kind of perpendicular drainage system is created by which the water is conducted still deeper into the earth and away from the ordinary vaporizing influences. The surface currents are divided and dispersed over the whole face of the ground by the numerous obstacles placed in their course, and in this way the formation of destructive torrents is prevented; while at all times the shade of trees retards evaporation and preserves the upper layers of the soil in a moist condition, a result which may be observ-

ed any day during the rainy season when the state of a road overhung with trees is contrasted with that of an open one. The most important use of forest, then, is to cause retention of the rain water in the soil; hence a perennial source for springs and rivers is produced, the flow of water is equalized and regulated, and the occurrence of earth-removing torrents is obviated.

When the woods of a country are exterminated, the rain water is no longer retained in the soil; instead of being absorbed and stored up as a supply of moisture for the feeding of springs and rivers, it flows rapidly off the surface in sudden floods and torrents, carrying in suspension vast quantities of earthy matter, which itself increases the abrading power of the current; the flow of springs and rivers and the humidity of the soil are diminished, while, as the natural consequence of this, all the lesser vegetation disappears, and in the hot season, more especially of a climate like that of India, the earth receives an undue amount of heat from direct exposure to the sun.

Of the evils resulting from forest destruction we have numerous well-known instances on record. In the case of South-Eastern France, the literature of the subject is very extensive and complete. The western slopes of the Maritime Alps and the hilly surface of the neighbouring Departments were formerly covered with forest, the climate

was exceedingly mild, trees of southern type flourished, springs flowed abundantly, the rivers were always more or less full, while the mountain torrents which naturally occur in a land of this kind caused little or no damage. For centuries the process of clearing the soil of trees went on, but so slowly that neither the want of timber or fuel nor the other evils about to be mentioned were seriously felt. Towards the beginning of the eighteenth century, however, clearing operations began to be more vigorously carried on. About the time of the first Revolution this pernicious work was being still more energetically proceeded with, and the mountain declivities were speedily denuded of their woods ; while the undergrowth was soon after destroyed by the browsing of cattle, sheep and goats. The appalling results of this destruction of forest are graphically described by French writers: the soil of the hillsides being no longer protected by the trunks and branches of the trees and undergrowth, or bound together by their roots, was rapidly washed down into the valleys, leaving only a surface of bare rock destitute of vegetation. One destructive inundation succeeded another, the cultivated lands were laid waste and covered with *débris* brought down by the mountain torrents, the river channels were alternately empty or filled with raging floods of muddy water, and in process of time they became

partially choked by sandbanks. The land was parched in summer, and the springs and wells dried up. The area of cultivated ground was progressively reduced in extent, and as the country became less and less habitable, it was gradually abandoned by the starving population. So enormous was the devastation thus brought about, that it was found necessary, from time to time, to enact what were called remedial legislative measures. None of these, however, proved of the least avail, the evil continuing unchecked, and it was not till the time of the second Empire—in fact within the last twenty years—that any really efficient steps were taken towards restoring the land to its former fertile state. Since then tree-planting, re-turfing, and the enclosure of districts to protect them from the depredations of man and other animals have been assiduously carried on, and with the most gratifying results. In Italy the clearing away of forests from the slopes of the Appenines and Alps produced much the same fatal consequences as followed their destruction in France. During the last few years measures similar to those which have proved so successful in the latter country have, I believe, been adopted to remedy the devastation. In no region of the earth have forests been exterminated to such an extent as in the United States: the denudation of many parts of the country appears

still to be carried on with unabated vigour. It is a common observation that the winters there have become colder, the summers drier, and the streams smaller; springs have dried up, hillsides have been denuded of their soil, and destructive inundations have become more frequent. All these phenomena are by universal consent rightly attributed to the clearing away of the woods with which the land was once covered.

The influence exercised by forests on the flow of springs, and on lakes and marshes in their vicinity, is very remarkable. We have many well-attested examples in the United States and in France where springs and wells have gradually dried up when the woods near their sources were cut down, while they have again appeared on the replanting of the locality or when a new growth of wood was allowed to shoot up naturally. Springs have also been observed to come into existence when a district has been planted for the first time. As regards large bodies of fresh water, it is maintained that the lakes of Switzerland have undergone a depression of level since the destruction of the woods. In New Granada, in South America, such a result has actually been witnessed in the case of two lakes when the adjacent forests were removed. A most instructive example bearing on this point is given by Boussingault in his *Economie Rurale*. It is as

follows,—The valley of Aragua in Venezuela is completely shut in by mountain ranges; the rivers which rise within it, having no outlet to the sea, form by their union the lake of Valencia. In the year eighteen hundred Humboldt visited the valley and found it inhabited by a prosperous and industrious population. Many of the people had noticed the gradual diminution which the lake had been undergoing for the previous thirty years: the town of New Valencia, originally founded at a distance of a mile and a half from the lake, was, at the time of his visit, three and one-third miles from the shore, while some hillocks on the plain retained the name of islands which they formerly bore when surrounded by water. Numerous hypotheses had been started to account for this change in the level of the lake. After a careful examination of the locality, Humboldt disposed of them all and came to the independent conclusion, hitherto overlooked by the other investigators, that the diminution of the water was due to the extensive forest clearings which had been made in the valley during the previous half century. Some of the water issuing from the wooded districts was taken up for irrigation, but by far the largest portion of it must have been lost through the evaporation caused by the earth being no longer protected from the sun's rays. It is possible too that an additional cause for the subsidence of the

lake might have been discovered in a diminished rainfall. The correctness of Humboldt's inference was subsequently established by Boussingault himself, who visited the valley in 1822. For some years preceding his arrival the inhabitants had observed that the waters of the lake were no longer retiring, but, on the contrary, were sensibly rising, and portions of the cultivated lands were already submerged. The explanation of these facts was not difficult. During the twenty-two years that had elapsed since Humboldt's visit, important political events had occurred; war had desolated the land and decimated the valley population; the great plantations were abandoned; and the forest, which in a moist tropical country so rapidly encroaches if allowed to do so, had in a few years again overgrown, in its original luxuriance, the greater part of the soil from which it had once before been removed. There is still current a belief, by some attributed to a statement in Pliny's Natural History, that the planting of trees tends to drain marshy ground. That the reverse is really the case will be gathered from the facts I have already detailed. In the United States it is always observed that clearing the country of trees not only causes the running springs to disappear, but also dries up the stagnant pools and marshy ground in the immediate vicinity.

The various facts I have now brought forward, if applied to the Deccan, are, I trust, sufficient not only to indicate the cause of its comparative aridity, but we may also obtain from them many useful suggestions towards providing a permanent remedy for the evil. In considering the influence supposed to be exercised by forests on the rainfall of a country and the effects which their supposed extension might be thought to involve, the most important point to be kept in view is the direction and character of the prevailing winds and the physical aspect of the countries over which they may have already passed. Most of the rainless regions of the earth are so not because their soil is dry and vegetation absent, but because the winds which blow over them are, from various causes, almost entirely devoid of moisture. Such is happily not the case here; we are, on the contrary, met at the very outset of our inquiry by one solid fact, and that is, the recurrence annually of the south-west monsoon, a warm moisture-laden wind, which blows over the Deccan for nearly four months continuously, and during that period deposits a considerable amount of rain. The first question to be asked is;—Can we by any means extract a greater average rainfall from this wind? Eminent authorities on the subject would reply in the affirmative, and declare that by planting every available spot with trees our desire

would be accomplished, more especially as parts of the Deccan are hilly. The matter would seem to stand thus:—We have a warm wind, charged with watery vapour, passing over the Deccan for nearly a third part of the year; were we enabled, therefore, to lower the temperature of the district by the agency of vegetation, I think that, taking into consideration the whole of the evidence, there can be little doubt that a more copious fall of rain might be wrung from the south-west wind. Under present conditions the greater part of its moisture, left after it has paid toll to the Konkan and Ghats, is reserved for the elevated forest districts of Central India and for the Himalayas. I should like to know what carried away the Nerbudda bridge last year, if it was not the rain that ought to have fallen over the Deccan.

But whether the theory that forest increases the precipitation of rain to an appreciable extent is true in practice or the reverse, we shall find, as I presently mean to show, that the judicious planting of the Deccan will enable its inhabitants to derive benefits from a rainfall no greater than the present one, which as yet have scarcely been even thought of. Certainly no steps have hitherto been taken, much less contemplated, in the direction I am about to point out, by which these prospective advantages can be made a reality.

The average annual rainfall of the Deccan,

computed on the returns for ten years, is twenty-five inches, a quantity which, were it properly economized, is, I maintain, amply sufficient to render this part of Western India infinitely more productive than it is now. We may well ask, though indeed I am not aware that the question ever has been asked, What becomes of such an enormous amount of water—more than two feet of it poured over the land every year?—To an observant and thoughtful person acquainted with the Deccan, the answer is obvious. The greater portion of this precious rainfall runs to waste, and instead of remaining stored up in the earth for future use, returns to the sea—the place from whence it came. It has been roughly estimated that under ordinary circumstances the average proportion of water entering the sea from a river is about one-third of the total rainfall over the drainage area; a part of the remainder is evaporated and carried off by the wind, to be precipitated somewhere else; while the rest is disposed of by the growing vegetation, by absorption into the soil and subsoil strata, and by sinking into the fissures and cavities of rocks. What is not evaporated by the sun and wind or used by vegetation is gradually given out from the earth and rocky fissures in which it is stored up, and where it forms a kind of reserve fund for the feeding of springs and rivers. Of the total rainfall of the Deccan, I do not think

I err greatly in estimating that, instead of only one-third being returned to the sea, at least four-fifths of it are carried off in a few months to the Bay of Bengal. The country is to a very great extent destitute of trees or even of shrubs; owing to their absence and to the hardness of the ground from exposure, the rain water, instead of being retained in the soil, flows rapidly off the surface. The numerous deep nullas with precipitous sides, and which are so common near the rivers and on the hill slopes, demonstrate but too clearly the devastating action of torrents; there is no shade to prevent evaporation; while the muddy floods in the rivers during the continuance of the south-west monsoon are ample proof that a large portion of the Deccan soil is annually carried away to assist in the extension of the deltas at the mouths of the Godaveri and Krishna. The drainage areas of both these rivers, those portions of them at least which lie in the Deccan, possess no means of averaging their discharge or of avoiding floods. There are no "flood moderators." In no part of their course is there a single lake; not one body of water even approaching such a thing; neither do they in the whole of their passage through the Deccan flow amidst forest or wooded country. It is a well-known fact that streams which run through lakes contain nearly the same quantity of water all the year round, and that forest

rivers are seldom flooded and never dry. From the effects they produce on the volume of a river, lakes and forests are hence termed "flood moderators," the action of the former in this respect being the most complete. With the Deccan rivers and their tributaries the reverse state of things prevails; during the few monsoon months they are invariably in full flood and their waters laden with suspended earthy matter, while for the rest of the year their beds are nearly or altogether dry. The latter circumstance reveals plainly enough the fact that the soil and the subsoil strata have retained, or rather received, but an infinitesimal proportion of the rainfall. It is a fact palpable to every observer, that the Deccan presents scarcely a single obstacle either to retard the rapid flow of rain water from its surface, or to equalize, in some degree at least, the amount carried along in its streams and rivers. Were it not for the abundant rainfall on the Deccan side of the Ghat watershed and for the retaining powers of the vegetation, such as it is, which exists in some places on the eastern slopes of the range, the rivers, for eight months of the year, would not contain a drop of water. Like the Deccan rainfall, however, an undue proportion of this copious precipitation also runs to waste and finds its way to the sea. Had we but a series of intercepting artificial lakes stretching along the

eastern side of the watershed, with sufficient vegetation on the declivities of the hills and on the collecting areas of the lakes for the purpose of retaining water in the soil and thus keeping the lakes always full, we should then be in possession of unfailing resources, capable to a very great extent of maintaining the rivers in constant flow.

I shall now pass on to discuss the several remedial measures that are demanded to prevent a continuance of the extremely objectionable state of matters I have described above as existing now and always in the Deccan. Most of these will probably have already been inferred from what I have set forth in the preceding paragraphs. The famine both in this Presidency and in Madras, calamitous as it has proved, need not be regarded as altogether an unmixed evil. One consequence of it must necessarily be to direct more attention to the means that lie within our grasp to increase immensely the water supply of the stricken districts. The very relief works themselves—the clearing out of old tanks and wells and the construction of new ones—are happily made to contribute to this desirable end. It is making use of one famine to prevent the recurrence of another! No exertion should be spared to add to the resources of the Deccan for the artificial storage of water, and for irrigation. It is especially in the vicinity of the Ghats that re-

servoirs should be constructed in order to intercept as large a proportion as possible of the more copious rainfall of the watershed.

But lakes and tanks scattered over a treeless country will not be sufficient to ensure an adequate supply of water for agricultural wants; most certainly they will not suffice in seasons of deficient rainfall. The volume of such bodies of water in an arid tropical climate like that of the Deccan must of necessity become rapidly less through surface evaporation, while there is no reserve in the soil or in the rocky cavities and fissures to replace the loss thus sustained. In connection with this point it should always be carefully borne in mind that we have to deal with a region where for the greater part of the year a fierce sun and a dry north-east wind exert an almost unlimited vaporizing power on a land destitute of trees or shade. In order therefore to provide the requisite reserve I propose that the catchment area of every lake and tank be planted with trees. The soil on which they stand will consequently be protected by their shade from the drying influence of the sun and wind, and the deeper strata will be preserved in a more or less moist condition owing to the retention in them of a large portion of the rainfall, which would otherwise have merely run off the surface and found its way to the sea, but which, if stored up in the earth, would constantly tend to percolate into the

lake or tank, and in this way help to make good the losses caused by evaporation and by the abstraction of water for irrigational purposes. Let the very instructive instance, already brought forward, of the lake in the valley of Aragua, the level of whose waters fell when the surrounding forest was cleared away, but rose again so soon as the denuded hillsides were permitted to resume their former luxuriant covering, be but kept in mind, and the reasonableness and practical utility of my proposition will be at once perceived.

I have, so far, disposed of the tanks and lakes of the Deccan, either existing or yet in futurity. To supplement the benefits that are certain to ensue from the clothing of their gathering grounds with vegetation, I have now to advise the planting with trees of all canal and river banks, as well as field boundaries of every description, of the road sides, and as far as practicable of the hills. Some of the latter are even now partially covered with stunted vegetation, and I have no doubt that in many cases they do manage to retain a certain amount of rain water which goes to supply the wells of the adjoining low grounds. I am not aware whether such is actually the fact, but I should infer that cultivated lands, lying along the foot of any Deccan range of hills which is at all furnished with wood or penetrated with numerous rocky fissures, must remain in a more or less humid condition long after the rest of the coun-

try has parted with its moisture and its vegetation has disappeared. The state of the crops or of the natural plant growth in the localities indicated would at once furnish evidence as to the correctness or otherwise of my inference. I shall be glad to hear of any instance of this being verified. Tree-planting in the vicinity of villages, more particularly on the elevated grounds, should also be encouraged. The villages best provided in this respect will be the least liable to suffer from scarcity of drinking water.

It is almost unnecessary to disclaim any intention on my part of recommending that the proposals I have put forward should be carried into effect all at once. The achievement of such a work, on the contrary, requires time; it must be proceeded with slowly but surely. The successful establishment of the young plantations will naturally depend to a great extent on what may be called the preliminary water supply; the work of tree-planting and the construction and filling of tanks will have to go hand in hand; but wherever a sufficiency of water already exists, whether in rivers or canals or in artificial reservoirs, there planting should be undertaken without delay.

In order to make my suggestions as practical as possible, I have included in the accompanying list those trees which are best suited to secure the important object I have in view. The list is of

course far from being complete; as the work proceeds, experience will cause many more to be added to it. In making a selection of this kind, however, there are various considerations to be attended to; we must take into account the value of the trees as timber or fuel, the quality of the shade they afford, their rate of growth, the depth to which their roots penetrate the earth, and the distance to which these extend in a horizontal direction, while the more of them that happen to yield products serviceable to man or animals the better. The chief useful or appropriate qualities, by which I have been guided in my selection, will be found noted in the list. This, moreover, contains none but trees either indigenous to the Deccan, or others for which its soil and climate are already known to be adapted.

At the risk of being charged with usurping part of the functions of the Forest Department, there are still a few observations I think it expedient to offer on subjects connected with the planting, and more particularly on the care and management of plantations. The ultimate success of my scheme, I need scarcely say, depends in a great measure on the most rigorous precautions being taken to protect the plantations from the depredations of man and browsing animals. The amount of injury and destruction the latter are capable of inflicting on vegetation, and thus

perhaps changing the climate and the whole aspect of a country, is perfectly incredible. One or two illustrative instances will suffice.—When the island of St. Helena was discovered, the greater part of its surface was covered with dense forest, and the valleys and ravines were wooded even to the water's edge. The introduction of goats into the island changed all this; from being constantly browsed upon, the young wood and undergrowth were soon destroyed, and effectually prevented from spreading or replacing the larger trees that had perished from natural decay or been removed by man. Nothing the goats could reach was allowed to grow, and by the end of the last century the work of destruction was almost completed. As if to add to the ruin, the goats also succeeded in causing the extinction of several species of plants peculiar to St. Helena and which were found nowhere else in the world. The effect of all this forest destruction was, if the older records are to be trusted, to lessen the rainfall; the country suffered from prolonged droughts, a thing formerly unknown; and the soil was desiccated from exposure to the sun and wind. From this time forward, however, more enlightened and common-sense views began to prevail; measures for replanting were taken and were attended with such success that the rainfall is said to have sensibly increased, and the droughts, from which the island had suf-

fered so severely, were no longer experienced. It is just possible that the replanting did not really increase the total amount of rainfall, but, if it had not this effect, it is hardly to be doubted that in this case at least its distribution was equalized by the restoration of the forest. In the Ionian Islands large herds of goats have, by browsing on the young trees, completely checked the continuation of forest growth. The older trees were not replaced, and where there were once woods of large extent is now an expanse of naked limestone rock. Judging from what we are in the habit of witnessing every day in this country, there is but too much reason for believing that many parts of the Deccan have been denuded of their wood through the destructive propensities of cattle and goats. It cannot be questioned that, even at the present moment, the latter animals are a powerful check to the extension of natural forest in most parts of Western India. I believe I am fully justified in asserting that were goats banished from the sheltered Deccan hillsides and but restrained within reasonable limits, all such localities would speedily become covered with wood. Camels, too, are notorious destroyers of trees and shrubs, and a similar charge may be brought against their drivers and owners. At Ahmedabad I have seen large handsome "Neem" trees being

ruthlessly stripped of their branches for the purpose of feeding camels; while the animals themselves take advantage of every opportunity to browse on the shrubs and young trees that happen to come in their way. The amount of damage thus caused annually to forest vegetation it is not easy to estimate. But the human inhabitants of the country are the worst destroyers of all; it is deplorable to see the senseless, the reckless manner in which all kinds of wood, outside forest reservations, are treated by the villagers—they hack, cut, and burn to their hearts' content, laying waste in their dense ignorance the most precious gifts they possess. It is time that this ignorance were dispelled and the people taught to appreciate, to ever so small an extent, one at least of the means with which nature provides them for averting famine.

There is yet another matter which it seems to me has never so far received the attention it merits. I allude to the forest "under-growth." This term is applied to the mass of shrubs, grass, and other small vegetation by which the ground in forest districts is more or less thickly clothed. It assists the trees in tempering the heat and in retarding evaporation from the surface; while it forms by far the most efficient obstacle to the rapid flow of the rain water, and also serves to prevent the soil and humus, or vegetable mould,

from being washed away. Now, in many parts of Western India it is the custom to burn the undergrowth annually. In consideration, however, of the highly important purposes it serves, the very reprehensible practice of destroying it by fire cannot be too strongly condemned. Not only is a great portion of this undergrowth actually killed, but the trees themselves are scorched and their development checked; evaporation from the surface is greatly promoted, and the ground receives an undue amount of solar heat; and it is besides frequently charred and rendered so hard and impermeable both from the effects of fire and the sun's action, that the rain water must necessarily flow from it at first as it would off a naked rock. This picture is not in the least overdrawn, rather the reverse. I have more than once witnessed the results I have attempted to describe as following a forest fire. The principal reason assigned for this annual laying waste—namely, that fresh pasture for the village cattle may be obtained on the setting in of the rainy season,—serves but to show that yet another element of destruction, in the shape of cattle, is introduced into the forest. No matter in what light we view this procedure of burning, nothing but evil is to be seen. What the fire spares the cattle ruin; they browse on the young shoots, break down the branches and slender trunks, and by their heavy

tread expose and bruise the roots of the trees, which frequently die from this cause alone.

I have now to summarize briefly the results I should expect to follow were the Deccan but furnished, to a reasonable extent, with a forest-growth adapted to its soil and climate. With a change of this nature in the physical features of the country, the ground would become damper and cooler, the rivers would contain less water during the monsoon and more in the dry season than they do under existing conditions; tanks and wells, by percolation into them from the moisture-laden earth, would be compensated for the losses they sustain from evaporation and the abstraction of water for economic and other purposes; the soil would no longer be washed away by torrents or heavy rains; much of the land now lying idle might be brought under cultivation; the tender growing cereals, by being sheltered from the blasting winds that at present sweep unchecked across an open, treeless country, would be allowed to develop into something much more luxuriant and productive than the half-grown scanty crops so characteristic of Deccan agriculture. As a last, but by no means the least, consideration, the climate would be rendered moister and more equable. When I assert that the expenditure necessary to bring about so desirable, so beneficial a state of things, would be repaid a hundred-fold, I

do no more than give utterance to a conclusion that must force itself on the mind of every unprejudiced inquirer who rightly studies the subject.

Should the foregoing remarks cause any really practical attention to be given to a matter the vital importance of which I have endeavoured, however imperfectly, to make plain, I shall be more than satisfied. Or, if what I have written has no other effect than to lead a few thoughtful persons to examine the subject for themselves, and by their influence to aid in the dissemination of correct notions regarding it, I shall also have reason to be pleased. To me it seems extraordinary that this question should not have been fully discussed long since by some who are more competent to deal with it than I am, and who have had besides more and better opportunities of becoming acquainted with the facts that bear upon it. Not even the occurrence of a famine with all its attendant evils, or the publication of my letter in the *Bombay Gazette* more than six months ago, imperfect and fragmentary though it was, appear to have awakened the smallest degree of intelligent interest in the subject. It is after all to the gradual enlightenment of the people, under competent guidance, that we must look eventually for the accomplishment of the design I have attempted to sketch out.

W. GRAY.

Bombay, August 1877.

A List of the Trees suited for planting in the Deccan.

Botanical Names.	Vernacular or English Names.	Remarks.
Guazuma tomentosa.....	.....	Native of South America. An excellent shade tree. Leaves and fruit make good fodder.
Grewia tiliaefolia.....	Damun	A good shade tree. The bark yields a strong fibre.
Feronia elephantum.....	Kaitha. Wood Apple.	A large spreading tree. Timber good.
Melia indica	Nim	Well known. Attains a large size in the Deccan. Excellent for shade.
Soymida febrifuga	Rohin	A large shade tree. Timber valuable. Bark possesses febrifugal properties.
Chickrassia tabularis	Pubha. Bastard cedar.	A large shade tree. Wood useful.

Botanical Names.	Vernacular or English Names.	Remarks.
Cedrela Toona	Toon	A large shade tree. Timber very valuable.
Chloroxylon Swietenia.....	Billu. Hulda. Satin-wood.	A moderate-sized tree in the Deccan. Timber very valuable.
Zizyphus jujuba	Bher	A fast-growing shade tree. Timber makes excellent fuel. Fruit edible.
Schleichera trijuga	Kusim	A large shade tree. Yields good timber.
Sapindus emarginatus	Arita. Soap-nut...	A spreading shade tree. Fruit saponaceous.
Pistacia terebinthus	Turpentine tree ...	A small fast-growing shade tree, a native of South Europe. Lately introduced into Bombay. Easily propagated.
Mangifera indica	Mango. Am.....	One of the very best shade trees. Admirably adapted for the Deccan.

Buchanania latifolia	Pial	A spreading tree. Seeds edible.
Semecarpus Anacardium...	Bhilawa. Marking-nut.	Useful for shade.
Butea frondosa	Palas	A small, but useful shade tree. Common in some parts of the Deccan, but more so in Khandesh. In most instances it has suffered sadly from the depredations of cattle and goats.
Dalbergia latifolia.....	Sisu. Blackwood...	A valuable timber tree.
D. paniculata.....	Padri	A large shade tree.
Pongamia glabra	Karanj	A valuable shade tree. Grows to a large size in the Deccan.
Parkinsonia aculeata	Jerusalem thorn ...	A small, thorny, fast-growing tree, native of America. Common now in Bombay. Is well fitted for hedges. Branches useful as fodder, and its wood as fuel.
Hardwickia binata	Anjan.....	An excellent timber tree.

Botanical Names.	Vernacular or English Names.	Remarks.
Tamarindus indica	Amli. Tamarind ...	An admirable shade tree. Timber good. Seeds eaten in times of scarcity.
Cassia florida.....	Kassod	Not indigenous, but now common in Bombay and about Poona. A fast-growing useful shade tree.
Prosopis spicigera	Shema	A middle-sized tree. Thrives best in a dry climate. Timber makes good fuel. Pods used as fodder for cattle, sheep, and goats; often eaten by the people too.
Pithocolobium dulce	Manila tamarind. Dakhani babul.	Not indigenous, although very common in Bombay. Grows rapidly. Excellent for shade. A good hedge plant if kept cut. Wood makes capital fuel. Pulp of pods eaten.
Albizzia odoratissima	Siris	

A. procera	Kinye	All fast-growing, spreading shade trees. Timber, more especially of the first, is excellent.
A. Lebbek	Siris	
A. stipulata	.....	
A. amara	Lullei	
Acacia arabica	Babul	Its qualities as a fast-growing timber and fuel tree are well known. Grows best when self sown. An indifferent shade tree however. Young shoots and pods make good fodder.
A. leucophlæa	Hewar	Somewhat resembles the preceding. Bark contains much tannin. Pods eaten as a vegetable.
Terminalia belerica	Bhadee	Large spreading shade trees. Fruit of the first two are the myrobalans of commerce. The last tree is seldom allowed to grow to any size in Western India; is kept down by lopping and injured by fire. Makes excellent fuel.
T. Chebula	Heerda	
T. Arjuna	Arjuna-sadra	
T. tomentosa	Ain	

Botanical Names.	Vernacular or English Names.	Remarks.
Anogeissus latifolia	Dhaura	A valuable timber tree.
Eugenia Jambolana	Jambul	A large fast-growing shade tree. Fruit edible.
Stephegyne parvifolia	Kadam	A large spreading shade tree. Wood excellent.
Bassia latifolia	Mohwa	Large spreading shade trees. Yield excellent timber. The fleshy flowers contain a quantity of sugar and are dried and eaten. From those of the first mowrah spirit is distilled in Bombay. Seeds yield a useful oil.
B. longifolia	Mohwa	
Mimusops indica	Kirni	A large spreading shade tree. Fruit eaten. Wood excellent.
M. Elengi	Bukal.....	A valuable shade tree.
Diospyros montana	Goindu	Good shade tree. Timber hard and durable.

D. Chloroxylon	Ninai	Good shade tree. Timber hard and durable.
Cordia Myxa.....	Bhokar	Fast-growing shade trees.
C. Rothii	Gondni	
Salvadora persica.....	Mustard tree.....	A small but capital shade tree.
Millingtonia hortensis.....	.....	A native of Burma. Grows luxuriantly about Poona. Is propagated from suckers. An admirable shade tree and well fitted for roadsides and boundaries. Grows rapidly. Has wide-spreading roots.
Spathodea falcata	Mersingi	A small but useful shade tree.
Tectona grandis	Sag. Teak	The only objection to this well-known tree is the length of time it remains leafless during the dry season.
Gmelina arborea	Sewan	A fast-growing tree. Yields good timber.
Santalum album	Chandan. Sandal...	This valuable tree might be largely propagated in the Deccan. Though small, it makes a good shade tree.

Botanical Names.	Vernacular or English Names.	Remarks.
Ficus indica	Wad. Banian	All well-known splendid evergreen shade trees. The fourth is the least eligible in this respect. Roots extend to great distances and are capable of opening up the hardest soil. All are readily propagated.
F. tomentosa.....	.....	
F. Tsiela	Pipri	
F. religiosa	Pipul	
F. cordifolia	Pair	
F. retusa	Nandruk	
F. glomerata.....	Umbar	
Artocarpus integrifolia.....	Phunnus. Jack-fruit tree.	A valuable shade and timber tree.
Ulmus integrifolia	Wawali	A large deciduous timber tree.

Trewia nudiflora	Petari.....	A useful shade and timber tree.
Briedelia montana	Asana	A good shade tree. Leaves useful as fodder.
Aleurites triloba	Bengal walnut	An excellent shade tree. The walnut-like fruit is edible.

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